CS341 SYSTEMS BIOLOGY I

HOMEWORK ASSIGNMENT #2 – READING AND CODING (THURS SEPT 14, 2017)

1. Coding

The purpose of this assignment is to familiarize yourself with the type of Matlab code you will need to write in the projects. In the projects, you will be simulating models, then analyzing the output. The code here is designed to given you practice plotting and analyzing data.

Typically, your code should be organized in a folder, with a main script file called main_script.m. In that file, you will use the "cell mode" so that you can evaluate chunks of code at will (for example, you may have one cell that runs the model, and then different cells which analyze the data or plot it differently). There should also be a file for every support function. For biological oscillators (which we will study later), one important analysis function is getPeriod, which returns the period length of the oscillation.

1.1. Start the main script.

Create a file and call it main_script.m. Put this code at the top:

```
%% Cell 1.
% Generate data
t = 0:0.1:360; % time steps (in hours)
desiredPeriod = 24; % in hours
desiredAmp = 4.5; % in arbitrary units (a.u.)
y = desiredAmp/2 .* (1 + sin( t.*(pi/12) )');
```

It is designed to draw a sine curve that troughs at zero, peaks at desiredAmp, and has period desiredPeriod. Convince yourself you understand the line that calls **sin**. This is meant to be a stand-in for simulation results.

1.2. Add plotting functions to the main script.

Create a second cell in the file (using %%) and plot the "results". Include x- and y-labels.

Then add code to highlight the peaks. In other words use **hold** on and then re-plot the data, but use only the data at the peaks, and make the symbol a magenta triangle. Also, make the background of the figure white, so that it would look good included in a write-up.

1.3. **Add code to compute the peak-to-trough amplitude.** Create a third cell in the file. Compute the peak-to-trough amplitude of the cell and display it alongside the "correct" amplitude (i.e. the value of desiredAmp). The output should look something like this:

```
The desired amplitude is 4.5 and the computed amplitude is 4.5
```

2. Write the getPeriod function

For very smooth data (which ours will be), it is possible to compute the period using a "stroboscope" method. In other words, if you have a signal over 15 cycles, you can find the some point on all 15 cycles (such as the peak), then use the times of those markers to compute the period. With 15 cycles, you will have 14 period values. The official period of the data is the mean of those 14 values.

Write a getPeriod function that computes the period of the data. I have found that a good marker is the point at which the signal crosses the mean as its value rises. In other words, find the places marked with the red star in Figure 1. Use the difference in time between those points to compute the period.

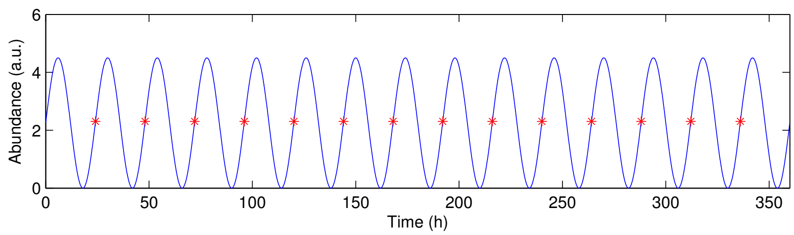

Figure 1. Demo of the points that you should use to compute the period. The red stars indicate the places at which the signal crosses the mean on its way up (i.e. when it has positive slope).

Now, here is the real challenge: Do this without using any for loops! It can be done. There are probably lots of ways to do it. Have fun and be clever :).

Hint: I use the **diff** and **find** functions, along with functions associated with sets (O.k., just one function – intersect).

2.1. **Test it with different periods and amplitudes.** Verify that your methods work with different periods and amplitudes. For most values, this is a trivial change. But you could push them to the point at which it breaks down. Wouldn't that be fun? What are the limits of period and amplitude for this set-up? Answer in general terms (i.e. how big or little could the period be, given the time array we are using)?

2.2. **What to turn in.** Zip (or tar or both) up a file containing your code files. I have found that just attaching a .m file often puts the code in the text of the email itself, and then it becomes difficult for me to run it.

3. (Short, Fun) Reading

(1) Read "Can a biologist fix a radio: or what I learned while studying apoptosis" by Lazebnik, 2002 (sent in an email by Stephanie). Note that apoptosis is "programmed cell death". Apoptosis is an important part of healthy development – for example, without apoptosis we would have webbed feet!
   (a) Briefly summarize the central metaphor of this paper and the main points the author is making. (Answer in approximately 3 sentences.)
   (b) Compare this article to those of Kitano. How do the recommendations of Lazebnik relate to those of Kitano? (Answer in approximately 3 sentences.)

(2) Read "The tale of neuroscientists and the computer" by Brown et al., 2014 (sent in an email by Stephanie).
   (a) Briefly describe the central metaphor of this paper and the main points the author is making. (Answer in approximately 3 sentences.)
   (b) Contrast this paper to the previous paper. Does it add any new ideas or perspectives? (Answer in up to 3 sentences.)