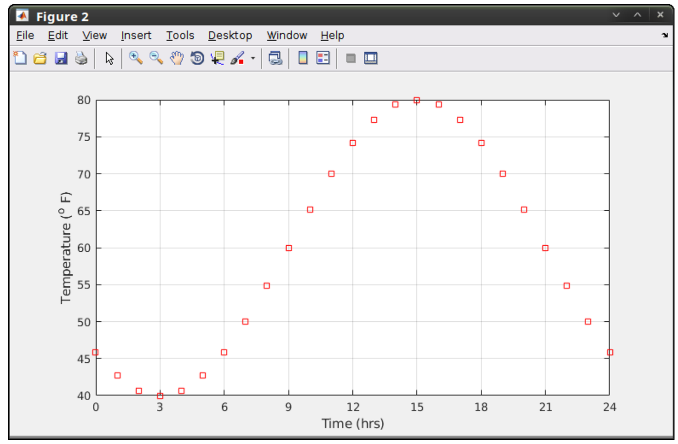
1 - Problem:

As we all know, the temperature on the surface of the earth fluctuates throughout the day (see figure 1). The temperature on earth is therefore a function of time. For simplicity, let's assume that the temperature can be described by the following equation:



$$y(t) = R \cdot \sin\left(\frac{2 \cdot \pi}{24} \cdot (t - t0)\right) + B \quad (1)$$

Where the variables are:

y, the temperature (in ^{c}F)

t, the time of day (in hrs)

And our constants are:

R is the range in daily temperature (in °F)

t0 is the 'off-set' time of day (in hrs)

B is the 'bias' temperature (in °F)

1 - Questions:

Your assignment is to write software capable of determining the constants for 4 different locations on earth

Location	R (°F)	t0 (hrs)	B (°F)
Philadelphia, PA	25	9	55
Panama City, FL	10	9	72
Brewster, MA	15	9	59
Enugu, Nigeria	13	9	73

1 - Software Solution:

1.A - Write a function (ca1_fun1.m)

This function must do the following (requirements)

1. *Input 1 (eq_cnst)*
   a. Receive the equation constants as an input vector [1x3]
2. *Input 2 (t_data)*
   a. Receive the time (hrs) variable as an input vector [Nx1]
3. *calculation*
   a. Use equation 1 to determine temperature based on the input constants and input time variable
4. *Output (y_temp)*
   a. Output the temperature (deg F) as a vector [Nx1]

1.B - Write a script (scrpt_ca1fun1.m)
This script must do the following (requirements)

1. *Define time variable*
    a. Create a vector starting at 0, ending at 24 and spaced every 1 hr
2. *Define constants*
    a. Create a [1x3] vector of constants
        i. (1,1) = [R] temperature range (deg F)
        ii. (1,2) = [t0] time offset (hrs)
        iii. (1,3) = [B] temperature bias (deg F)
3. *Calculate temperature variable*
    a. Use ca1_fun1 to calculate temperature
4. *Plot results*
    a. create a figure and plot time (x-axis) vs temperature (y-axis)
    b. Be sure to label axes
5. *Determine the constants (range, t0, B) used to generate the data in figure 1.*
    a. Change the constants and run your script repeatedly
    b. Comment on how you knew you were 'right'

2 - Problem:

After we exercise, our heart rate slows down to 'normal' (see figure 2). What you may not know, is that this return to base-line can be described by an exponential function (equation 2):

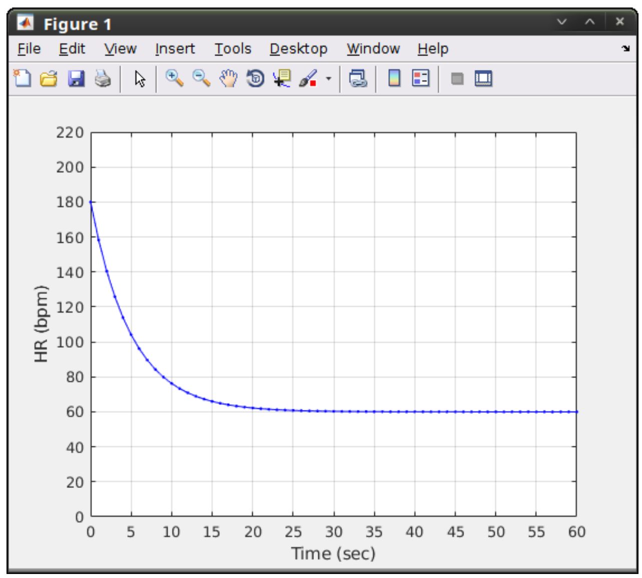
$$y(t) = D\exp\left(\frac{-t}{\tau}\right) + B \qquad (2)$$

Where the variables are:

y, the heart rate (in beats/min)
t, the time (in sec)

And our constants are:

D is the increase in HR (in BPM)
τ is the decay constant (sec)
B is the base-line HR (BPM)



2 - Questions:

______Since D is the increase in heart-rate, B is the base-line and the decay rate (τ) has been shown to be inversely proportional to how fit a person is (the more fit a person, the less time it takes to return to base-line), generate 3 figures for fit, average, unfit subjects to the same exercise (walking up 3 flights of stairs) based on these values.

Fitness	D	tau	B
Unfit	120	20	75
Average	60	10	60
Fit	40	5	40

2 - Software Solution:

2.A - Write a function (ca1_fun2.m)
This function must do the following (requirements)

1. *Input 1 (eq_cnst)*
    a. Receive the equation constants as an input vector [1x3]
2. *Input 2 (t_data)*
    a. Receive the time (sec) variable as an input vector [Nx1]
3. *calculation*
    a. Use equation 2 to determine heart rate (BPM) based on the input constants and input time variable
4. *Output (y_temp)*
    a. Output the heart-rate (BPM) as a vector [Nx1]

2.B - Write a script (scrpt_ca1fun2.m)
This script must do the following (requirements)

1. *Define time variable*
    a. Create a vector starting at 0, ending at 60 and spaced every 1 sec
2. *Define constants*
    a. Create a [1x3] vector of constants
        i. (1,1) = [D] increase in heart-rate (BPM)
        ii. (1,2) = [τ] decay constant (sec)
        iii. (1,3) = [B] base-line heart-rate (BPM)
3. *Calculate heart-rate variable*
    a. Use ca1_fun2 to calculate heart-rate
4. *Plot results*
    a. create a figure and plot time (x-axis) vs heart-rate (y-axis)
5. *Determine the constants (D, tau, B) used to generate the data in figure 2.*
    a. Change the constants and run your script repeatedly
    b. Comment on how you knew you were 'right'

Constraints:

1. All work (code and other materials) are due (in bblearn) PRIOR to class the following week
2. All software must be written in MATLAB
3. University Policies (see course syllabus)
4. Course Policies (see course syllabus)
5. All axes must be labeled

Additional Requirements:

1. Your name must appear in your software (commenting in your m-files) in order to receive credit (Your name can appear in multiple m-files)
2. Variable names must be related to the data contained in the variable
3. Commenting must include ALL software solution steps
4. Commenting must explain the 'choices' within your code (for example if your code has something like, dt(:,1), you must comment why column 1)