

**Morgan State University**  
**Department of Electrical & Computer Engineering**

**EEGR 415: C Programming Applications**

**Project 1**

**Objective:**

The objective of this project is to create an application that simulates the capabilities of a function generator. Your application should present the user with a menu where the user can choose to generate a:

1. A sinusoidal signal
2. A square wave signal
3. *A sawtooth signal (extra credit: +10)*

If the user doesn't select one of the menu options, an error message should be displayed. The program should not exit until the exit option is chosen from the menu (the menu should repeat until the exit option is chosen). For each wave form, the following parameters should be read from the user and applied to the wave:

1. Frequency (in Hertz; minimum of 1Hz)
2. Amplitude (in Volts; minimum of 0V)
3. Phase shift (in milliseconds; minimum of 0ms)
4. Vertical shift (in Volts)

You don't have to account for the user entering a non-numeric value (if they do, your code will crash...that's fine for now). Selecting "Exit" from the main menu displays a dialog "Good Bye" then your program should exit.

*Extra credit (+10): Place the code to get the frequency, amplitude, phase shift and vertical shift in a method that verifies that the frequency and amplitude is positive before "returning" all four values back to main method. This method should be called three times (one for each type of signal to be generated)*

*Extra credit (+10): If the user selects cancel from the 'Generate Signal' menu then return user to the main menu. If the user selects cancel from the Main Menu then exit the program.*

The program should provide **two options** to output the data, one to the screen using the Java Plot functions, the other to a text file with a '.csv' extension (ie. Signal.csv). Your program should produce a data point every 10 milliseconds. The text file should contain two columns, separated by a comma. The first column should be time, and the second column should be the amplitude value of the signal (in volts). The time axis should go from 0 to 2000 milliseconds.

### **Menus:**

This is the expected menu structure for your program:

#### Main Menu

1. Generate Signal
  - a. Generate a sinusoidal signal
  - b. Generate a square signal
  - c. Generate a sawtooth signal
  - d. Return
2. Add Noise
3. Plot Signal
4. Export Signal
5. Exit

### **General Information:**

A sine wave (or sinusoid) is a mathematical function that describes a smooth repetitive oscillation. In its most basic form as a function of time, it is given as:

$$y(t) = A \cdot \sin(\omega t + \phi)$$

where:

- A, is the amplitude (in volts for this project)
- $\omega$ , is the angular frequency (in radians per second)
- $\Phi$ , is the phase

One can add a displacement value to  $y(t)$  to vertically shift the resulting wave up or down.

### **Grading:**

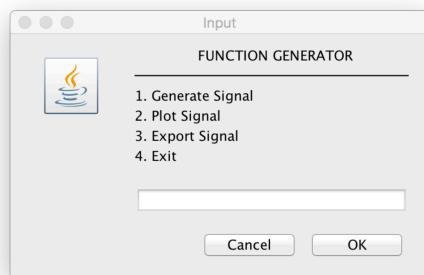
- Display the menus correctly (with input validation) using dialog boxes; and program exits correctly (40 pts)
- Able to populate array with sinusoidal signal values (using provided frequency, amplitude, phase, and vertical shift) (15 pts)
- Able to populate array with square signal (using provided frequency, amplitude, phase, and vertical shift) (15 pts)
- Show an appropriate message if user tries to plot or export data before it is generated (5 pts)
- Able to plot the last signal generated correctly (as shown in the **Expected Output** section) (15 pts)
- Able to export the data and produce the plots in Excel (10 pts)

*Extra Credit:*

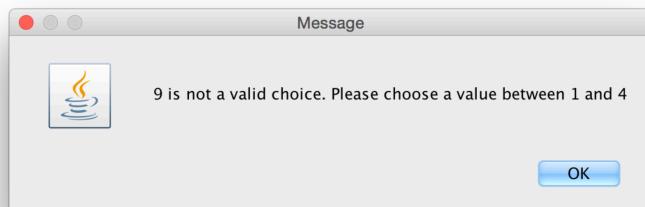
- Able to populate array with sawtooth signal (using provided frequency, amplitude, phase, and vertical shift) (+10)
- Pressing cancel either takes the user to the previous menu or exits the program (+10)
- Using a method to get validated input for signal parameters (+10)

**Expected Output:**

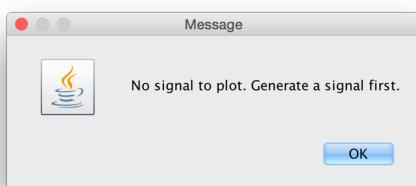
When your program is run, produce the following dialog:



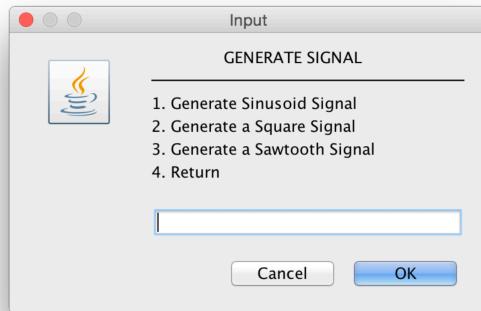
Enter a number outside the range of a menu should generate an error message dialog like:



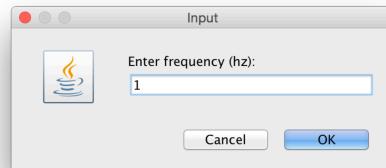
Selecting to plot a signal or export a signal before it is generated should produce the following dialogs:



Select option 1 from the main menu “Generate Signal”, produces this menu:

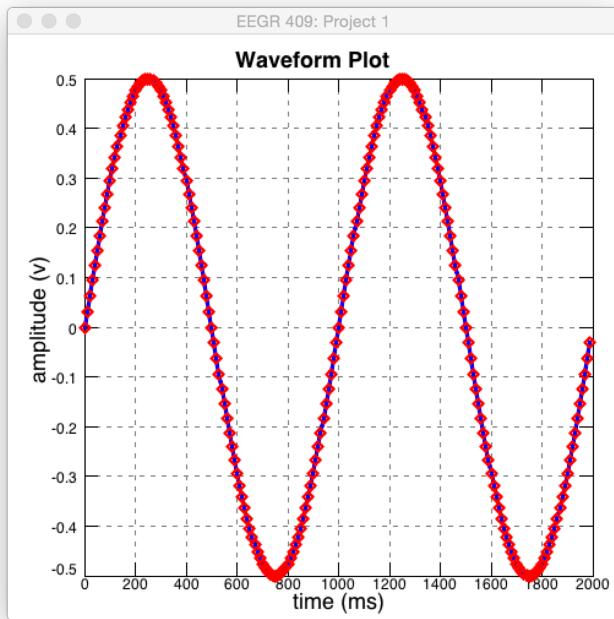


Selecting options 1 – 3 produces a series of input dialogs where the user enters the 1) frequency, 2) amplitude (peak-to-peak), 3) phase (degrees) and 4) vertical shift.

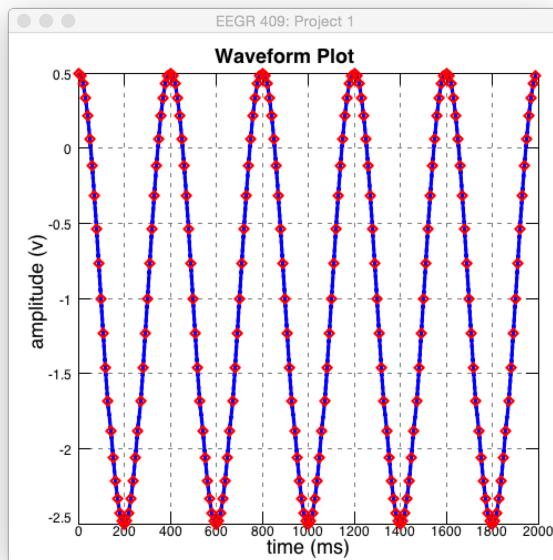


After the last input dialog (vertical shift) has been displayed, the user is returned to the “Generate Signal” menu. Selecting option 4 (return) will display the main menu. Clicking the “Cancel” button will also return the user to the main menu.

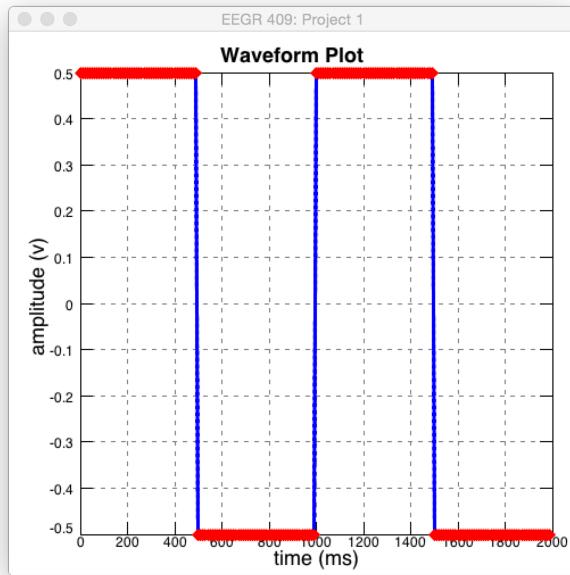
From the main menu, selecting option 2 (Plot Signal) will plot the last signal generated. The following is the expected plot for a sinusoid of 1Hz, amplitude 1Vpp, phase shift 0 degrees, vertical shift 0V:



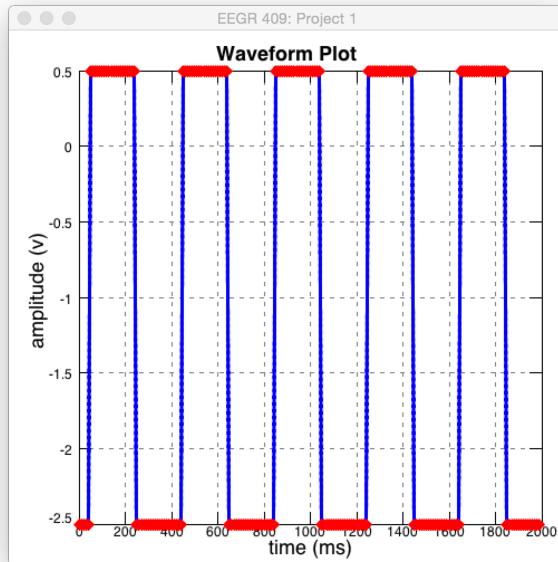
This is the expected sinusoid waveform at 2.5Hz, amplitude 3Vpp, phase shift 90 degrees, vertical shift -1V:



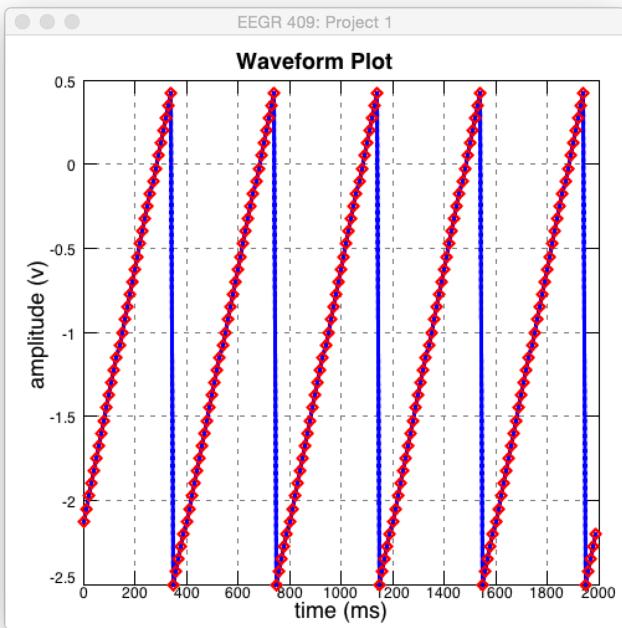
This is the expected square with 1Hz, amplitude 1Vpp, phase shift 0 degrees, vertical shift 0V:



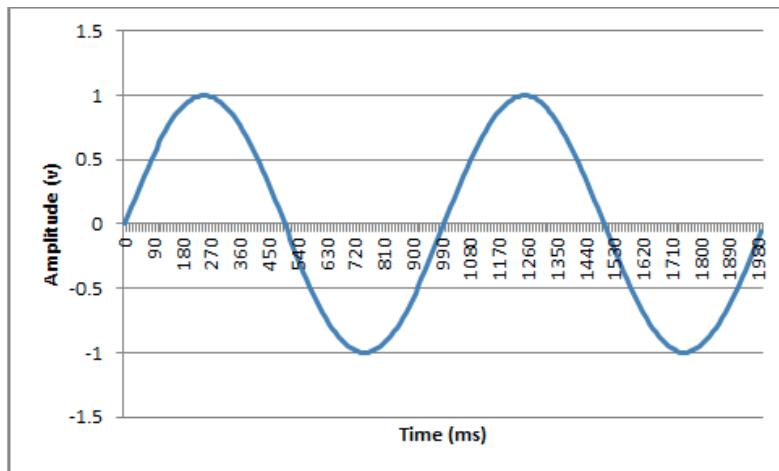
This is the expected square waveform at 2.5Hz, amplitude 3Vpp, phase shift 135 degrees, vertical shift -1V:



This is the expected sawtooth waveform at 2.5Hz, amplitude 3Vpp, phase shift 225 degrees, vertical shift -1V:



Option 3 from the main menu (Export Signal) should produce a text file, ‘waveform.csv’, where each line consists of the time and signal voltage separated by a comma. Import this file into Excel and produce a plot of each of the waveforms (this Excel file must be included in your submission to Black Board).



#### **WARNING:**

If you try to run your code while your output file is open in Excel, your code may crash. Please close Excel before running your code.