Project ECE2560 Sp 2022

Collaboration with other students is not allowed

Step 1:

Write a subroutine named ABS with the following contract:

```
;-------------------------------------------------------------------------------
;                                   Subroutine Name: ABS
;                          A(output) = Absolute value of N(input)
;Stack Picture:
;SP ->  Return Address
;       Output, A (word)
;       Input,  N  (word)
;-------------------------------------------------------------------------------
Functionality:
A = Absolute Value of N
```

All **input**, **output** and **local** variables (if required) should be **handled on the stack**. Do not use core registers or .text/.data variables in the subroutine. To obtain the absolute value of a number, check if it is negative, if it is then multiply it by -1.

Hint:

According to Lesson1 Page 9:

- -1*number is obtained by finding the 2's compliment of the number.
- 2's compliment of a number = (1's compliment of the number + 1)
- In assembly language, 1's compliment is obtained by using the **inv.w** operation, i.e., inv.w numb

Step 2:

- Watch Screencast2 and look at Lesson1 to review 2's compliment representation
- Watch **Importing/Plotting Data in CSS** (posted on your website) from 10:20 to the end to review importing data into Microcontroller memory from your disk and plotting data from memory in CCS.

Step 3:

Download SineTable.txt from the lessons tab of the website and rename it SineTable.dat. This file contains data for one period of a sinusoidal wave.

Step 4:

Write a main program which does the following:

Create an array named **input** of 256 (word length) elements (using .space) in .text region.
Create an array named **output1** of 256 (word length) elements (using .space) in .data region.
Create an array named **output2** of 256 (word length) elements (using .space) in .data region.

Import data from the file SineTable.dat into the array named **input**.
Plot this data as a graph in CCS.
Attach the following two screenshots to your submission:

i) Memory Browser showing at least the first 100 elements of the array **input**.
ii) Plot of array **input** (showing the x-axis and y-axis)**.**

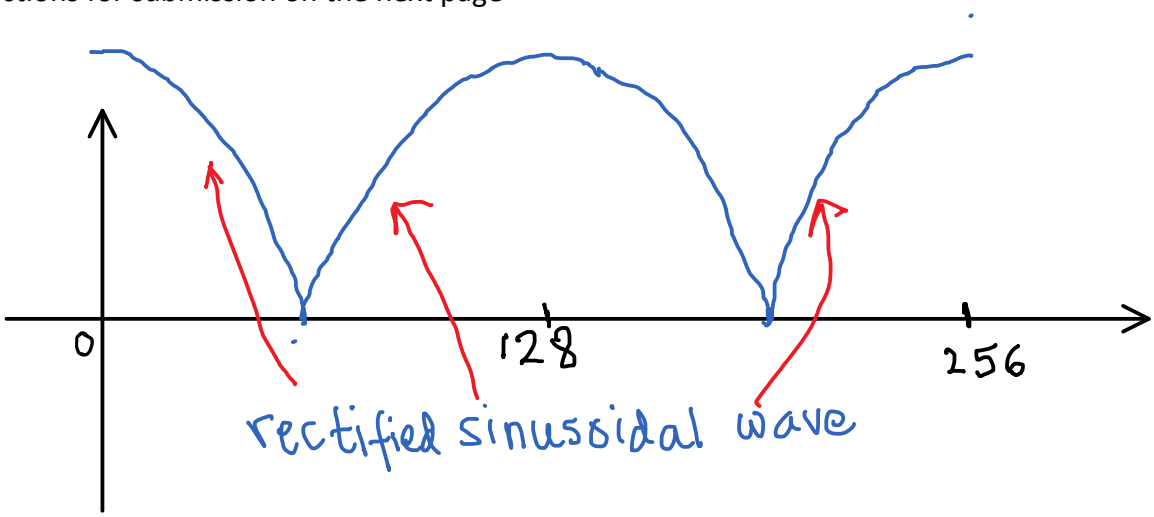
Subtract decimal **425** from each element of the array **input** and store it in the array **output1**.
Attach the following two screenshots to your submission:

i) Memory Browser showing at least the first 100 elements of the array **output1**.
ii) Plot of array **output1** (showing the x-axis and y-axis)**.**

Use the subroutine **ABS** to write code so that **output2** contains a rectified version of the sinusoidal wave contained in **output1**, so that **output2** looks like the blue curve in the figure below.
Attach the following two screenshots to your submission:

i) Memory Browser showing at least the first 100 elements of the array **output2**.
ii) Plot of array **output2 (**showing the x-axis and y-axis)**.**

… instructions for submission on the next page



Instructions: Use the word template and instructions contained on our web site to submit your screenshots to Carmen. Do not email directly to your TA or me. Files emailed to the TA or me will not be accepted. Include the following in your submission:

i) Assembly language source code of the whole program, including the **main** program and the **subroutine**.
ii) Pseudo code of the **subroutine.**
iii) Screenshot of the "General" tab of the properties screen of your project.
iv) Screenshots of the memory browser and graphs mentioned at various points in the project document, after the program has been executed/resumed (by pressing the green play button in the debugger):

and paused/suspended (by pressing the pause button in the debugger):

Use "16-bit Signed Int" format in the memory browser.

Note: It is your job to figure out the addresses of the various arrays in the memory browser. You will need these addresses to view (in the memory browser) and to plot the arrays.