

Homework Assignment #6

Course: COP 3223C – Intro to Programming with C

Semester: Spring 2018

Credit Value: 4% of Final Grade

Due Date: April 16, 2018; 2:59 PM

Structures and Circular Arrays

You work for a secret government laboratory that does highly advanced research in nuclear energy for peaceful applications. The lab has a small working plutocritical nuclear reactor that has been yielding very promising results. We'd like to say that you are the Chief Scientist of the Instrumentation and Control department ... but you are not. You are just a first-year software engineer. Nevertheless, you have been given a very important assignment.

The reactor has been behaving unstably recently, with suddenly oscillating power levels that come on very suddenly and disappear just as suddenly, followed by long periods of normal operation. Given that we are dealing with a nuclear reaction, this is not a good thing. The problem has been generally traced to the polyfundus cavity of the hyperclastic chamber, deep within the bowels of the reactor. The transmogrifier unit that controls the poison rods of the reactor has been observed to violently shake on occasion by people who happened to be walking by when the power oscillations took lace –a rather discomforting thing that is far from being normal. So ...

You have been asked to write some software to add to the transmogrifier that measures and saves the last 10 seconds prior to and the 10 seconds after a sudden positive change in the glottal pressure of the main transmogrifier intake valve assembly. At the same time, the temperature and the flow of the liquid sodium in the reactor are to be measured and saved to try to better understand the causes of this new phenomenon.

Your code will gather and store the data collected. The recording event will be triggered by a **positive change** in glottal pressure of 150 psi or more. However, because months may pass between abnormal events, all the data collected cannot be kept in the small memory element of the transmogrifier. You just need to collect the critical 21 seconds' worth of data (one data point per second of real time).

You will need to capture and store four pieces of data:

- a) The time in seconds (`int t`).
- b) The transmogrifier inlet glottal valve pressure (`float tp`).
- c) The transmogrifier liquid sodium flow (`float tf`).
- d) The transmogrifier liquid sodium temperature in degrees C (`float tt`).

You will need to create a structure (`struct`) that when instantiated, its instance variables will hold the three values read and the time at which the readings were made. There will be one `struct` instance for every measurement taken (one per second). The 21 `struct` instances will be put into a circular array of size 21. Then, the results will be printed in a table displayed in the transmogrifier computer screen.

The output should look as follows (without the lines in the table): **Note: This table is an example! Your program should replicate the output format but not these same values!!!!**

Time (secs)	tp (psi)	tf (gpm)	tt (Deg C)
-10	500	15	572
-9	527	10	553
-8	595	11	500
-7	610	10	590
-6	530	12	583
-5	601	10	526
-4	621	12	544
-3	581	11	508
-2	574	13	515
-1	<u>542</u>	15	512
0	<u>699</u>	12	581
1	527	16	600
2	675	17	565
3	591	20	575
4	579	10	584
5	608	12	579
6	633	11	555
7	650	17	593
8	540	14	538
9	575	12	513
10	621	16	546

The trigger event will be recognized whenever a **positive** change in pressure of at least 150 psi is computed between one tp measurement and the next. At that point, the next 10 measurements will be saved (regardless of their value), the process will stop and the table will be printed to screen as well as to a file (see below).

Then, write code so that the same data are saved to an external file called `output.txt`. This file should not be submitted along with the assignment, but should be created by your program. Note that there is no need for your program to incorporate the ability to read in the values from the file after they have been stored.

However, you do not yet have access to the measuring devices to test your code, so, you will have to simulate the measurements. You will do this through a random number generator in a UDF that returns numbers within the appropriate range. Never mind that the numbers will be meaningless for now. You merely want to test out operation of the circular array, the struct instances and the printout functions. The ranges of each variable are as follows:

tp: 500 to 700 psi.
tf: 10 to 20 gpm
tt: 500 to 600 deg C

Musts:

You **must** use the following elements in the program:

1. A `struct` structure
2. An array of size 21.
3. A random number generator `rand()`
4. At least two user-defined functions: one to generate the random numbers and another to do the printing.
5. The `typedef` data specifier for the structure.
6. You **must** use at least two separate files for your program
7. Do NOT use global variables.
8. Lastly (and obviously!), your program **must** be written in C and **must** compile with the gcc compiler and execute correctly.

Submission Instructions

As with HW assignments #1, 2, 3, 4, and 5, this assignment must be submitted via Webcourses (Canvas) as a .c file. It will not be accepted any other way.