**Data Structures (2028C) -- Spring 2022 – Lab 6**

***Topics covered: Stacks and Queues***

*Lab due:* ***Sunday, Feb 27 at 11:59PM for Monday Section***

***Tuesday, Mar 1st at 11:59 PM for Wednesday Section***

**Objective:**

The objective of this Lab is to examine stacks and queues built using C++. This will take the famous “Towers of Hanoi” game and modify the rules to be a challenge between 2 players.

**Task 1:** Create a stack class that will be used as the basis for the remainder of the lab.

1. Create a new project. You can name this whatever you like.
2. Design a stack class using an array. This class should be a template.
   1. The constructor should include a parameter to indicate the size of the array.
   2. The array holding the data should be an array of pointers.
   3. The push function should accept a pointer and add that pointer to the top of the stack. It doesn’t need to create any memory.
   4. The pop function should return a pointer. It doesn’t need to delete any memory.
   5. The top function should return a pointer to the item on the top of the stack without removing it.
   6. The length function will return an int indicating the number of items in the stack.
   7. The empty function should empty the stack of all contents. It needs to call delete to avoid memory leaks. It doesn’t need to return any value.
   8. Create the implementation code for the above functions as required. **Do not** use cout in the class. Any errors such as overflow or underflow should throw a custom class error.

**Task 2:** Create a queue to track steps.

1. Create a queue class. This class should be a template.
2. Design the queue class using an array to store data. Include the standard functions for a queue. This should be very similar to the functionality described in Task 1.

**Task 3:** Working with text

1. Write code to read a series of strings from a file, reverse the order of the text in each word while keeping the words in the same order. This must utilize both the stack and queue classes from tasks 1 and 2.  
   Example input:

This is a test.  
Output:  
sihT si a tset.

1. Include in the lab report a screen shot(s) of the output of a test. Include a diagram of what the stack and queue look like in solving the sample above (you may need to show various views of a single stack and queue).

**Lab Submission:**

1. Write a lab report including the following information:
   1. A description of the objectives/concepts explored in this assignment including why you think they are important to this course and a career in CS and/or Engineering.
   2. The sections from each task indicated to be included in the lab report.
2. Include all source code from all tasks, input and output files (if any), and any special instructions to compile and run those programs.
3. Package all files in a single zip folder and submit the file to canvas.

**Lab Grading:**

1. 20% - Lab attendance
2. 15% - Task 1 has been correctly implemented and meets all requirements.
3. 10% - Task 2 has been correctly implemented and meets all requirements.
4. 15% - Task 3 has been correctly implemented and meets all requirements.
5. 20% - Task 4 has been correctly implemented and meets all requirements.
6. 20% - Lab report contains all required information and is well written.

If program fails to compile, 0% will be given for that Task.