Data Structures
BITL1

Worksheet 5

Fall 2020

8 October 2020

1. **Warm up:**

   (a) What is the difference between a stack and a queue?

   (b) True or False: A stack takes up less space than a queue.

   (c) True or False: An implementation can be made that is both a stack and a queue.

2. The **complexity** of an algorithm is $O(f(n))$ if as $n \to \infty$, where n is the size of the input, the algorithm takes at most $M|f(n)|$ time, for some $M \in \mathbf{R}$.

   Suppose that Algorithm 1 is $O(n^a)$ and Algorithm 2 is $O(n^b)$, where $a, b \in \mathbf{N}$.

   (a) Give another function $f(n) \neq n^a$, so that Algorithm 1 is $O(f(n))$.

   (b) What is the complexity of both algorithms together?

   (c) What is the complexity of Algorithm 1 on an input of size $n + c$, for $c \in \mathbf{N}$?

   Suppose that Algorithm 3 is $O(2^{n+1})$ and Algorithm 4 is $O(2^{2n})$.

   (d) Is Algorithm 3 $O(2^n)$? Is Algorithm 4 $O(2^n)$?

3. Suppose that you have implemented a **circularly linked list** as in Exercise 5, and that your cursor is at the first element (index 0) of an input of length n.

   (a) If you repeatedly call `add(0); advance(); advance();`, how many times must this pattern be repeated for the cursor to pass index 0 n times?

   (b) If you can only remember one value of the list at a time, what is the smallest number of commands that must be made called to reverse the input? Use only the commands of the circularly linked list class.