CS5008 Spring 2022

Homework 3

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1. Circular queues are used quite a bit in operating systems and high performance systems, especially when performance matters. Do a little outside research, and explain the reason a ring buffer useful and/or when should it be used?

On this homework, we implemented a circular queue data structure. A circular queue is essentially a queue with a maximum size or capacity which will continue to loop back over itself in a circular motion.

This ring buffer data structure is a common data structure frequently used when the input and output to a data stream occur at different rates. For example, for the CPU scheduling and memory management for our computer. The good side of ring buffer is that it doesn't use dynamic memory, so there will be no memory leak. On the other hand, it conserves memory as we only store up to our capacity.

When we need to do all operating in constant time in a FIFO way, using ring buffer will be a good choice. And we also don't need to reorganize it after implementation, which saves a lot of time.

Citation: "Circular Queue or Ring Buffer", https://towardsdatascience.com/circular-queue-or-ring-buffer-92c7b0193326

2. We are going to talk about stacks quite a lot in this course, so it will be important to understand them. Do a little outside research, and explain why a stack useful and/or when should it be used?

Stacks are important data structure; we understand it as LIFO (last in first out). Stacks are useful for processing nested structures or for functions which call other functions. A nested structure is one that can contain instances of itself embedded within itself. For example, algebraic expressions can be nested because a subexpression of an algebraic expression can be another algebraic expression. Stacks are used to implement functions, parsers, expression evaluation, and backtracking algorithms. As we will see in the future algorithm courses, all recursions can be implemented by stacks data structures.

Examples of using stacks are virtual machines or interpreters that utilize a stack architecture to save the running state during execution of functions or procedures. As for time complexity of CRUD, popping an element from a stack will take O(1) time complexity. Popping the last element in a stack will take O(n).

Citation: "Stack (abstract data type)",
https://en.wikipedia.org/wiki/Stack_(abstract_data_type)#Applications