Section 05: Midterm Review

1. Stacks and Queues

Consider a sequence of characters and the task is to reverse the sequence. Is it beneficial to use a stack or a queue to perform this task? Assume that stacks and queues are implemented using linked lists and each node in the linked list stores a character.

2. Asymptotic Analysis

For each of the following, choose a $c$ and $n_0$ which show $f(n) \in O(g(n))$. Explain why your values of $c$ and $n_0$ work.

(a) $f(n) = 5000n^2 + 6n\sqrt{n}$ and $g(n) = n^3$

(b) $f(n) = 2^n$ and $g(n) = 3^n$

3. Recurrences

Solve these recurrences (give a Big-Theta bound). If the master theorem is applicable, state which case you used. If you use unrolling or the tree method, show your work.

(a) $T(n) = \begin{cases} 1 & \text{if } n = 1 \\ T(n/2) + n^2 & \text{otherwise} \end{cases}$

(b) $T(n) = \begin{cases} 1 & \text{if } n = 1 \\ 2 \cdot T(n/4) + \sqrt{n} & \text{otherwise} \end{cases}$

(c)

4. AVL/BST

Insert \{6, 5, 4, 3, 2, 1, 10, 9, 8, 6, 7\} into an initially empty AVL tree.

5. Heaps

Insert \{6, 5, 4, 3, 2, 1, 10, 9, 8, 6, 7\} into an initially empty min-heap. Write down the final heap as an array.
6. Hash tables

(a) Consider the following sequence of numbers.

6, 29, 41, 34, 10, 64, 50

Suppose the hash function is \( h(k) = 2k \). Insert each number into the following hash tables and draw what their internal state looks like:

(i) A hash table that uses linear probing, with internal capacity 10. Do not worry about resizing.

(ii) A hash table that uses quadratic probing, with internal capacity 10. Do not worry about resizing.