

Fall 2018, CMPSC 465: practice for Exam 3 (was a conflict exam for some students).
Closed book and closed notes, no 'cheat sheet', no calculators allowed.
Please don't use cell phones during the exam.
Answer questions in the space provided.
The exam is for 40 points.

NAME: _____ SECTION: _____

1. Draw the 7-item hash table resulting from hashing the keys 2, 4, 7, 11, 12, 16, 20 using the hash function $h(i) = (2i + 1) \bmod 7$ and assuming collisions are handled with open addressing and linear probing.
(6 points)
2. Draw a binary tree with height 4 and maximum number of external nodes. Is this tree unique?
(6 points)

3. Complete the pseudocode for the `remove(p)` operation in a doubly-linked list, where a node p is deleted and previous and next pointers are updated. What is the worst-case asymptotic running time?

(5 points)

Algorithm `remove(p)`:

$t \leftarrow p.\text{element}$

_____ /* linking out p */

_____ /* linking out p */

_____ /* invalidating the position p */

$p.\text{next} \leftarrow \text{null}$ /* invalidating the position p */

return t

Running time: _____

4. Describe how to implement a stack using two queues. What is the running time of the `push()` and `pop()` methods in this case?

(6 points)

5. Show that the problem of finding the k^{th} smallest element in a heap takes at least $\Omega(k)$ time in the worst case.
(6 points)

6. Suppose we perform a DeleteMin operation on the min heap $H = [1, 2, 3, 5, 6, 8, 11, 15]$ (the heap is stored here implicitly in the form of an array). Show the steps performed after deletion to restore the heap order of elements.
(5 points)

7. Insert items with the following keys (in the given order) into an initially empty binary search tree: 30, 40, 50, 24. Draw the tree that results after each insertion.
(6 points)