**Data Structures and Algorithms I**

**Spring 2018**

**Homework #3**

1. For each of the following questions related to sorting algorithms or selection algorithms, express the desired information using big-Theta notation in terms of N. Assume that the N items are stored in an array.
2. What is the average-case running time of a typical implementation of quicksort applied to a sequence of N items? **Θ(NlogN)**
3. What is the worst-case running time of a typical implementation of quicksort applied to a sequence of N items? **Θ(N2)**
4. What is the average-case running time of a typical implementation of mergesort applied to a sequence of N items? **Θ(NlogN)**
5. What is the worst-case running time of a typical implementation of mergesort applied to a sequence of N items? **Θ(NlogN)**
6. What is the memory requirement of a typical implementation of quicksort applied to a sequence of N items, not including the original array? **Θ(logN)**
7. What is the memory requirement of a typical implementation of mergesort applied to a sequence of N items, not including the original array? **Θ(N)**
8. What is the worst-case running time of a typical implementation of a least-significant-digit radix sort (as discussed in class) if eight passes are used to sort a sequence of N 64-bit unsigned integers? **Θ(8\*N) = Θ(N)**
9. What is the memory requirement of a typical implementation of a least-significant-digit radix sort (as discussed in class) if eight passes are used to sort a sequence of N 64-bit unsigned integers, not including the original array? (Assume that each bin uses a linked list to store the items placed into the bin.) **Θ(N)**
10. What is the worst-case running time of a typical implementation of quick select (as discussed in class) applied to find the median of a sequence of N random items, if median-of-three pivot selection is used to choose the pivot? **Θ(N2)**
11. What is the worst-case running time of a typical implementation of quick select (as discussed in class) applied to find the median of a sequence of N random items, if median-of-five pivot selection (a.k.a. median-of-median-of-five pivot selection) is used to choose the pivot? **Θ(N)**
12. For each of the following questions related to regular binary search trees or balanced binary search trees, express the desired information using big-Theta notation in terms of N and/or M, as appropriate. (When both N and M are mentioned, you cannot assume one is larger than the other.) Assume that all balanced binary search trees are AVL trees, as discussed in class.
13. What is the average-case total running time of time of N additional insertions of random values into a regular binary search tree initially containing M random values? **Θ(Nlog[N+M])**
14. What is the worst-case total running time of time of N additional insertions of random values into a regular binary search tree initially containing M random values? **Θ(NM+N2)**
15. What is the average-case total running time of time of N additional insertions of random values into a balanced binary search tree initially containing M random values? **Θ(Nlog[N+M])**
16. What is the worst-case total running time of time of N additional insertions of random values into a balanced binary search tree initially containing M random values? **Θ(Nlog[N+M])**
17. What is the average-case running time of N searches for random values in a regular binary search tree containing M random values? **Θ(NlogM)**
18. What is the worst-case running time of N searches for random values in a regular binary search tree containing M random values? **Θ(NM)**
19. What is the average-case total running time of N searches for random values in a balanced binary search tree containing M random values? **Θ(NlogM)**
20. What is the worst-case total running time of N searches for random values in a regular balanced search tree containing M random values? **Θ(NlogM)**
21. What is the worst-case running time of an inorder traversal applied to a regular binary search tree containing M items? **Θ(M)**
22. What is the worst-case running time of an inorder traversal applied to a balanced binary search tree containing M items? **Θ(M)**