**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(N)
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(NlogM)
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)
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(NlogM)
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(NlogM)
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(N)
22. What is the worst-case running time of an inorder traversal applied to a balanced binary search tree containing M items? Θ(N)