American University of Armenia
CS 121 Data Structures A

Homework Assignment 3

1. (3 points) Write a program using recursive method(s) that generates all binary strings without consecutive 1's of given length n.

  (a) What does your program output for input $n = 6$?

  (b) How many recursive calls does it make on that example?

  (c) What are the numbers of resulting strings of lengths 5, 6, 7?

  (d) What is the number of resulting strings of length n? Explain.

2. (2 points) Write (a) a recursive and (b) a non-recursive methods that, given a character array c of length n, check whether that array is a palindrome.

3. (2 points) Write a program that performs bubble sort on an integer array S of length n.

  (a) What is the largest number of comparisons that your algorithm makes (as a function of n)?

  (b) What is the worst-case running time of bubble sort? Explain.

  (c) Give example inputs of length 8 for which the running time of the algorithm is the best and the worst.

4. (2 points) Write a program that performs bucket sort on a lowercase array S of length n.

  (a) What is the largest number of bucket insertions/removals that your algorithm makes (as a function of n)?

  (b) What is the worst-case running time of bucket sort? Explain.

  (c) How will your implementation and its running time change if we also include uppercase letters?

5. (2 points) Write a program that performs insertion sort on an integer array S of length n.

  (a) What is the largest number of comparisons that your algorithm makes (as a function of n)?

  (b) What is the worst-case running time of insertion sort? Explain.

  (c) Give example inputs of length 8 for which the running time of the algorithm is the best and the worst.

6. (2 points) Write a program that performs selection sort on an integer array S of length n.

(a) What is the largest number of comparisons that your algorithm makes (as a function of n)?

(b) What is the worst-case running time of selection sort? Explain.

(c) Give example inputs of length 8 for which the running time of the algorithm is the best and the worst.

7. (2 points) Show the execution of the merge sort algorithm on the sequence $\{5, 1, 6, 4, 7, 3, 9, 1, 6\}$.

(a) What is the number of comparisons that your execution makes?

(b) What is the worst-case running time of merge function on sequences of lengths m and n?

(c) What is the worst-case running time of merge sort? Explain.

8. (2 points) Show the execution of the quick sort algorithm on the sequence $\{6, 1, 9, 3, 7, 4, 6, 1, 5\}$.

(a) How do you choose the pivot?

(b) What is the number of comparisons that your execution makes?

(c) What is the worst-case running time of quick sort? Explain.