Assignment 1

Due on Sunday 10/11, 11:59 PM

1. In insertion sort, for the array [4, 6, 9, 2, 8, 1, 3, 7], how will the array be after the 4th iteration?
   - (a) [4, 6, 9, 2, 8, 1, 3, 7]
   - (b) [1, 4, 6, 9, 2, 8, 3, 7]
   - (c) [1, 2, 4, 6, 9, 8, 3, 7]
   - (d) [1, 2, 4, 6, 9, 8, 3, 7]
   - (e) None of the above.

2. Consider the following recurrence
   \[ f(n) = \begin{cases} 
   2, & \text{if } n = 1, \\
   f(n-1) + f(n-2), & \text{otherwise}.
   \end{cases} \]

   Which of the following is true?
   - (a) \( f(n) = 2^n \)
   - (b) \( f(n) = \phi(n) \)
   - (c) \( f(n) = \phi(n) + f(n) \)
   - (d) \( f(n) = 2n \)
   - (e) None of the above.

3. “Questions on insertion sort is an example of an increased algorithm.” This statement is
   - (a) True
   - (b) False

4. Consider the following two statements
   
   Statement A: In an array, all elements are sorted in ascending order.
   
   Statement B: Insertion sort sorts the array in ascending order.

   Which of the following is true?
   - (a) Both the statements are true
   - (b) Statement A is true but statement B is false
   - (c) Statement B is true but statement A is false
   - (d) Both the statements are false

5. What is the average case time complexity of merge sort?
   - (a) \( O(n \log n) \)
   - (b) \( O(n) \)
   - (c) \( O(n \log n) \)
   - (d) \( O(n^2) \)

6. Consider an array of elements \( x, y, z, w, \) what are the steps of insertion sort?
   - (a) \((x, z, y, w, z)\) + (x) = (x, z, y, w, z)
   - (b) \((x, z, y, w, z)\) + (x) = (x, z, y, w, z)
   - (c) \((x, z, y, w, z)\) + (x) = (x, z, y, w, z)
   - (d) \((x, z, y, w, z)\) + (x) = (x, z, y, w, z)

7. For any function \( f \) on any array \( x \), does an insertion sort algorithm ever get all of:
   - (a) \( f(x) \)
   - (b) \( f(x) \)
   - (c) \( f(x) \)
   - (d) \( f(x) \)

8. What is the average case time complexity of an insertion sort algorithm?
   - (a) \( O(n) \)
   - (b) \( O(n^2) \)
   - (c) \( O(n) \)
   - (d) \( O(n) \)

9. Which of the following is correct with regard to insertion sort?
   - (a) Insertion sort is stable and it is suboptimal
   - (b) Insertion sort is stable and it is not suboptimal
   - (c) Insertion sort is unstable and it is suboptimal
   - (d) Insertion sort is unstable and it is not suboptimal

10. Assume that a merge sort algorithm is the worst case time \( O(n \log n) \) for an array of size \( n \). Which of the following must closely mirror the execution layout size of a problem that can be solved in \( O(n \log n) \) time?
    - (a) 100
    - (b) 100
    - (c) 100
    - (d) 100