

Student ID: \_\_\_\_\_

Student Name: \_\_\_\_\_

**CS203 Data Structure and Algorithm Analysis****Quiz 1**

**Note 1:** Write all your solutions in the question paper directly. You can ask additional answer paper if necessary

**Note 2:** If a question asks you to design an algorithm, full marks will be given if your algorithm runs with optimal time complexity

**Note 3:** If a question asks you to design an algorithm, you should **first** describe your ideas in general words, **then** write the pseudocode, and **end** with time complexity analysis.

**Problem 1 [15 marks]** Please analysis the time complexity of the following algorithm line by line.

Selection-Sort (  $A[1..n]$  )

1. for integer  $i \leftarrow 1$  to  $n-1$
2.      $k \leftarrow i$
3.     for integer  $j \leftarrow i+1$  to  $n$
4.         if  $A[k] > A[j]$  then
5.              $k \leftarrow j$
6.     swap  $A[i]$  and  $A[k]$

Atomic operations per line:

Line 1: \_\_\_\_\_

Line 2: \_\_\_\_\_

Line 3: \_\_\_\_\_

Line 4: \_\_\_\_\_

Line 5: \_\_\_\_\_

Line 6: \_\_\_\_\_

Total cost (in terms of Big-O notation)  $T(n)$  is: \_\_\_\_\_

**Problem 2 [25 marks]** Let  $S1$  be an unsorted array of  $n$  integers, and  $S2$  is another sorted array of  $\log_2 n$  integers ( $n$  is a power of 2,  **$S2$  is in descending order**). Describe an algorithm to output the number of pairs  $(x, y)$  satisfying  $x \in S1$ ,  $y \in S2$ , and  $x \leq y$ . Your algorithm must terminate in  $O(n \log \log n)$  time. For example, if  $S1 = \{10, 7, 12, 18\}$  and  $S2 = \{15, 7\}$ , then you should output 4 because 4 pairs satisfy the required conditions:  $(10, 15), (7, 15), (12, 15), (7, 7)$ .

**Problem 3 [30 marks]** Design an algorithm to convert infix expression to postfix expression. (You can omit time complexity analysis in this problem).

**Then**, show the running steps of your algorithms for the following expression:

$$5 * ((9 + 3) * (4 * 2) + 7)$$

**Problem 4 [30 marks]** Design a function to check if a linked list is a palindrome.  
For example:

Linked list **A**: 1->2->3 is not a palindrome, return No.

Linked list **B**: 1->2->3->2->1 is a palindrome, return Yes.