Beijing-Dublin International College

SEMESTER I FINAL EXAMINATION - 2020/2021

School of Computer Science

COMP2010J Data Structures and Algorithms 1

HEAD OF SCHOOL: Chris Bleakley
MODULE COORDINATOR: Lina Xu*

Time Allowed: 120 minutes

Instructions for Candidates

The distribution of marks in the right margin shown as a percentage gives an approximate indication of the relative importance of each part of the question.

BJUT Student ID: _____ **UCD Student ID: _____**

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge：_____ (Signature)

Instructions for Invigilators

Non-programmable calculators are permitted.
Paper based books and lecture notes are allowed.
No rough-work paper is to be provided for candidates.

Obtained score
20

Question 1: Stack

a. You have a stack implemented based on an array of size 10, after the following operations, what is the array like? (10 Marks)

S.push(3), S.push(1), S.pop(), S.top(); S.push(5), S.push(10), S.top(), S.pop()

b. For linked based Stack implementation, how can you reverse the elements in the stack? For example, from Top->1->2->3->4 to Top->4->3->2->1 (10 Marks)

Obtained score
20

Question 2: List

a. Write a Java Method: Given a list of unique integers is stored in a Doubly Linked List (in no particular order). Given a pointer to the first node in the list, delete the node containing the integer x, and return a pointer to the first node. What is your algorithm worst, best and average complexity in Big O?

public Node deleteNode(Node first, int x)

(20 Marks)

Obtained score
20

Question 3: Queue

a. Using the operations of a queue (any types/implementations), write a static function that determines if a number is a palindrome (i.e. reads the same backward and forward; e.g. 12321, or 1221). The prototype for this function is given below.

```
public static boolean isPalindrome(int number);
```

(20 Marks)

Obtained score
20

Question 4: Map

a. When putting data into a HashMap, collisions may happen. Linear Probing is one of the common solutions. Explain in your words why we need "Available" options for the removed array cell.

(10 Marks)

b. How can you utilizing map to perform sorting with a linear time complexity? (10 Marks)

Obtained score
20

Question 5: Sorting and Complexity

a. Giving an array of integers with size of N. How can you find the $(N/2)_{th}$ largest value? Can you perform the task without sorting the array? What is the best time complexity can you achieve?

(20 Marks)