National College of Ireland

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Higher Diploma in Science in Computing – Year 1 – Part-time – HDCSDEVICTJAN18
Higher Diploma in Science in Computing – Year 1 – Part-time – HDSWD_INT_JAN
Higher Diploma in Science in Computing – Year 1 – Part-time – HDSDICTJAN18OL

Semester One Examinations – January 2019

Wednesday 9th January 2019
10.00am – 12.00pm

Data Structures & Algorithms

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Mr. Glen Ward

Answers All Questions

Duration of exam: 2 Hours
Attachments: None

1. Write a Node/ Link based Java class, called LinkedQueue<T>, which implements the Queue<T> interface, which contains the following methods (comment the methods to denote the purpose).
    - enqueue
    - dequeue
    - size
    - frontElement
    - isEmpty

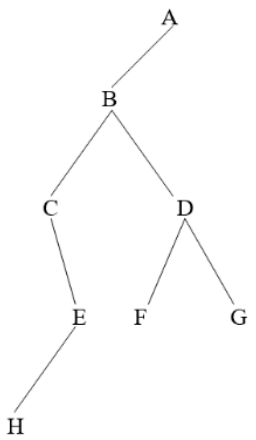
[30 Marks]

2. Define an ADT and describe its major parts. Which part is accessible to a user and which is not? Explain the relationships between an ADT and a class; between an ADT and an interface; and between an interface and classes that implement the interface. Provide a Java code for Stack data structure that uses commonly ADT.

[20 Marks]

3. Answer the following:

a) Consider the following tree and answer the questions below about the following binary tree:



- How many elements are present in the tree?
- How many leaves are in the tree?
- What is the height of the tree (Starting reference: 1)?
- How many children does C have?
- What is the parent of F?

[5 marks]

Perform (by just listing the nodes) the post order traversal of the tree.

[5 marks]

b) Illustrate and describe a stepwise procedure of the insertion of a new node into the middle of a doubly linked list. Assume the linked list has more than two nodes.

[10 marks]

4. Recursion, Sorting and Searching

a) Write a recursive method that finds the number of occurrences of a specified letter in a string using the following method header:

```
public static int count(String str, char a)
```

For example, count("Galway", 'a') returns 2. Write a JAVA program that prompts the user to enter a string and a character, and displays the number of occurrences for the character in the string.

[10 Marks]

b) Assume you have a collection of numbers represented as { 5 7 4 9 8 5 6 3 } that has to be sorted in an ascending order. Illustrate step-by-step how Insertion sort algorithm works on the given set of numbers.

[10 Marks]

c) Write an algorithm or JAVA code to search a number from an arbitrary list of integers by using a binary searching algorithm.

[10 Marks]