

**National College of Ireland**

**Higher Diploma in Science in Computing (HDSDEV\_JAN22)  
Higher Diploma in Science in Computing (HDCSDEV\_INTJAN22)**

**CA 2021 / 2022**

**Tuesday 26th of July  
120 minutes**

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**Data Structures**

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**This Assessment accounts for 50% of the overall grade for this module.**

**Paper Instructions:**

This is a practical CA, each of the following questions should be completed using Java. You need to provide extensive commenting to demonstrate your clear understanding of your solution. You should upload a single compressed folder consisting of all your files to Moodle prior to the deadline on the 26th of July. This assessment is an open book assessment and **not a collaborative exercise**.

All submissions will be subjected to comparison for plagiarism to ensure the integrity of the assessment.

Please answer **both** questions.

It should also be noted that an examiner may require to conduct a viva examination with you to further clarify any concerns with any submission.

The design explanation and any design decisions or assumptions made should be clearly stated in the comments in the relevant software files.

### Question 1:

- a) A software company wants to be able to track its current ongoing projects. Create a Node for a new Double LinkedList that is capable of representing a Software Project Progress Record. Each Node should contain the following information: Project Code, Project Managers Name, Project Description, Total person hours for the project e.g. 1500 hours, current Project status (OnTrack/ OffTrack ). The Node class should also provide a **toString** method to produce the following String representation:

#### Project Details

Project Code: "X123"

Project Managers Name: "Enda Stafford"

Project Description: "Widget Development"

Project Duration: 1500

Project Status: "On track"

You clearly demonstrate the Node object by creating an instance of the object and demonstrating your toString method. Adding each of the Software Project Nodes into the Double LinkedList represents the current list of projects in progress for the company.

**[20 marks]**

- b) Construct a new LinkedList that uses this Node. The LinkedList class should contain the following:
1. **References to first and last Nodes** – these references should enable for the identification of the first and last project nodes in the LinkedList [3 marks]
  2. **isEmpty** – this method should check if the LinkedList is empty and return a **Boolean** [3 marks]
  3. **currentProjects** - this method should return a String representation of the current ongoing projects within the LinkedList [3 marks]
  4. **get\_average** – this method should return the average project duration based on the current LinkedList [4 marks]
  5. **add** - this method should allow the addition of a new Node into the LinkedList **at the end of the current list** [4 marks]
  6. **remove** - this method removes the first occurrence of the **target Node**. The target is defined by Project Code [4 marks]
- Design and explanation of schema/implementation [3 marks]
- Testing of the implementation of the methods [6 marks]
- [30 marks]**

- c) Provide an implementation to add 5 different Projects into the LinkedList and clearly demonstrate the methods above **[5 \* 2 Marks]**

## **Question 2**

Provide a recursive solution to find all combinations of 4 numbers whose sum is 36. You should provide a recursive function that calls your method to demonstrate the implementation.

Declare and initialise an unsorted Array.

Implement a Recursive Function that accepts the Array and sum as parameters, to check if it contains four elements having the given sum.

For Example:

```
int[] intArray = { 14, 18, 12, 23, 6, 5, 1, 3 };
```

sum = 36

Output:

Quadruplet exists.

Below Quadruplets gives a sum of 36

(1, 5, 12, 18)

Design and explanation of implementation [5 marks]

Implementation of the design [17 marks]

Testing to ensure a fully working implementation [8 marks]

**[30 Marks]**

**Note: All solutions should be completed in Java and include extensive comments to demonstrate your understanding of your solution. The final 10 marks are going for comments, and how well structured your code is.**

**[10 Marks]**