

National College of Ireland

**Higher Diploma in Computing Software Development, HDSDEV_SEP, HDCSDEV_INT,
HDSDEV_SEPBL_YR1**

**Terminal Assessment
2023/2024, Semester 2**

Data Structures

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Paper Instructions:

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. This assessment is an open book assessment and not a collaborative exercise. In addition, you must also upload a short video (not to exceed 5 minutes in duration) of yourself explaining your code in English without reading the comments. All submissions will be subjected to comparison for plagiarism to ensure the integrity of the assessment.

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.

1. Stacks's are a common data structure. Provide an example of three real world examples of where you would implement a Stack.

[15 marks]

2. Differentiate between a sequential and a binary search, giving advantages and disadvantages of each type of search.

[15 marks]

3. Write a Java method *recursiveBinarySearch(int[] collection, int key)* that implements the binary search algorithm recursively to search for a target integer *key* within an array *collection* of integers, ensuring input data is suitably prepared for the search. The search requirements are outlined next:

Implement the binary search algorithm recursively.

Assume that the input array *collection* contains the following values { 72, 12, 23, 5, 2, 16, 8, 91, 38, 56}.

Ensure that the input data is suitable for the purposes of the search.

Search for the target value, *key* is equal to 23.

The method should return the index of the target if found, or -1 if the target is not present in the array.

The value returned from the binary search is displayed to the user using the console.

[30 marks]

4. Consider a scenario where you are tasked with developing a system to manage employee data for a medium-sized company. Each employee is identified by a unique employee ID (a 4-digit number e.g. 1234) and the system also records the employee's name and department (valid departments are, "HR", "Development", "Sales", and "Finance"). The system needs to efficiently store and retrieve employee information using a binary search tree (BST) that specifies the following operations:

- a) Develop a custom class called Employee that will hold employee information. The developed custom class will also implement the Comparable Java interface and provide natural ordering for employees.
- b) Implement methods for inserting a new employee into the BST and for searching for an employee based on their employee ID.
- c) Provide a method to return all employee records in the BST and print details of each record based on the numerical sequence of their employee ID.
- d) Allow for deleting an employee from the BST based on their employee ID.

The behavior of the BST will be described using a Java interface. Additionally, create a main method to demonstrate each of the BST methods implemented above and also to test the operation of the BST taking all of the major logical paths through the code you have implemented into consideration.

[40 marks]