Department of Electrical and Computer Engineering
North South University
MSC Qualifying Examination
Programming Language and Data Structures

(Sample Question Paper)

Total Marks: 75
Time: 3 hours

1 Linear search is an algorithm to find an element in a list (such as an array) by sequentially checking the elements of the list until finding the matching element.

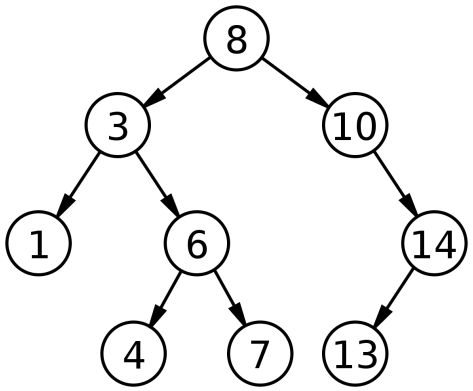
a) Binary search also can find whether an element exists in an array or not. Give one advantage of binary search algorithm over linear search algorithm. Explain the condition when you can apply binary search algorithm. 4 marks

b) Write down a code/pseudocode to illustrate how you can apply binary search algorithm over an array **recursively**. 6 marks

c) The following diagram shows a singly linked list in which **Head** is a pointer that holds the address of the first node in the linked list. 10 marks

Write down a program that will determine whether a particular element that we are looking for exists in the list or not. Your program should return a true if the element exists - otherwise a false.

2 Consider the following binary tree.



a) Explain if it is a binary search tree or not — 4 marks

b) The tree is traversed using the following traversal techniques: — 9 marks

1. Inorder traversal
2. Preorder traversal
3. Postorder traversal

For each of these traversal techniques, write down the sequence in which the nodes will be visited.

c) Write down a simple code/algorithm that will return the element stored in the rightmost node. — 7 marks

3 a) When you dynamically allocate objects in C++, you should be careful that your program does not have **memory leak** or **dangling pointer** issues. With the aid of examples, explain what do you understand by these terms. — 6 marks

b) With the aid of examples, explain the difference between static and dynamic binding. — 6 marks

c) What is the advantage of using generics in programming? — 3 marks

d) What is *aliasing* in the context of programming languages? Explain the context in which it arises and provide examples of the phenomenon. — 5 marks

4 a) Java supports both interfaces and abstract classes. Both may be used to define specifications. Compare these two concepts as supported in Java — 4 marks

b) When a class *b* is derived from a class *a*, class *b* may add new properties, or it may redefine properties defined in *a*. How do addition of properties affect the subtyping relation between parent and child? How do redefinition affect the relationship? 4 marks

c) Write down a few characteristics that we find in imperative languages. 4 marks

5 Graph is a non-linear data structure consisting of a set of vertices and edges. A graph can be mainly represented in two ways: (1) Adjacency list, and (2) Adjacency matrix. State when you prefer a graph to be implemented using adjacency list and that of adjacency matrix. Explain your choice. 3 marks