CS211 – Data Structures

June 19, 2023 *Final Exam* *Maximum Marks: 50*

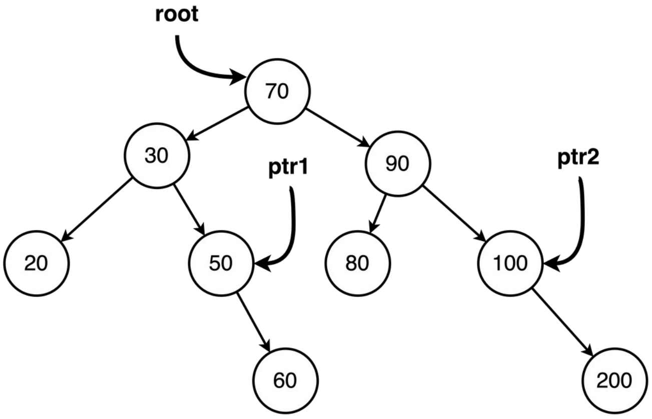
Q1. Insert the values 7, 11, 1, 8, 4, 10, 6, 9, 5, 2, 3,12, one by one, in the following data structures. Assume that the data structures are initially empty. Show all the intermediate steps. Do not write any code for this question. [3+4+3=10]

a) Binary Search Tree

b) Max-Heap

c) Hash table of size 3 using chaining method.

Q2. Keeping in view the following Binary Search Tree and pointers pointing to specific nodes: [1+2+4+3=10]



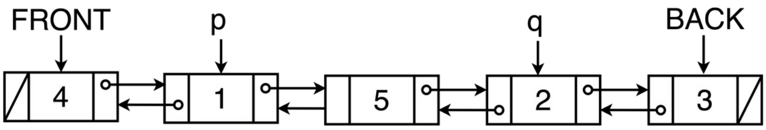
a) Write **ADT code** for displaying the value 50.

b) Write **ADT code** for displaying the value 80.

c) Write **ADT code** for deleting the node 30 without using any loops or calling any function. The resulting tree must remain a valid binary search tree.

d) How would the tree look like after deleting the node with value 70? (Do not write any code for this part, only draw the resulting tree).

Q3. Keeping in view the following doubly linked list and pointers pointing to specific nodes: [1+2+3+2+2=10]



a) Write **client code** to insert values in a list as shown in the figure above.

b) Write **client code** for creating two iterators, such that the first iterator points to the node *p* and the second iterator points to the node *q*. Do not use auto for declaring iterators.

c) Write **client code** to display all the values between *p* and *q* using the iterators defined in *part b* using a for-loop.

d) Write **ADT code** for declaring two pointers *p* and *q*, such that they point to the nodes as shown in the figure above.

e) Write **ADT code** to display all the values between *q* and *p* using the pointers defined in *part d.* Use a loop.

Q4. [5x4=20]

a) Write down the code for any of the following: selection sort, bubble sort, or insertion sort

b) Discuss the worst-case and best-base scenarios of the code written in part (a), find the time-complexities for the best-case and worst-case scenarios.

c) Find the exact time complexity of the code written in part (a). Assume that all the statements have the same computational cost.

d) Write any code having the following time complexities: $O(1)$, $O(n)$, $O(\log_2 n)$, and $O(n^2 \log_2 n)$.