

CSE 214
Computer Science II
Midterm 2 (Practice)
Total Marks: 50
Total Time: 50 minutes

Name: _____ Student ID: _____

(1) Write True/False for the following statements:

- a. In a red-black tree, no red parent should have a red-child.
- b. While deleting a node from a red-black tree we might encounter a double-red problem.
- c. The preorder traversal of an AVL tree gives a sorted sequence of the keys stored in the nodes.

(2) Which of the following is the worst-case running time for searching a key in a red-black tree?

- a. $O(n)$
- b. $O(\log_2 n)$
- c. $O(n \log_2 n)$
- d. $O(n^2)$

(3) Which of the following is the average-case running time for a sequential search in an array of elements?

- a. $O(n)$
- b. $O(\log_2 n)$
- c. $O(n \log_2 n)$
- d. $O(n^2)$

(4) Given the following integer values

50, 20, 80, 10, 30, 70, 90, 25, 40, 35, 45, 32, 37

(a) construct a binary search tree by inserting the elements in their given order.

(b) Draw the binary search tree after the following three lines of code

```
Btree.delete(30);  
Btree.insert(33);  
Btree.delete(80);
```

(c) What is the height and the inorder traversal sequence of the final tree after the operations performed in (b).

(5) The following array represents a heap stored in an array in the manner discussed in the lecture.

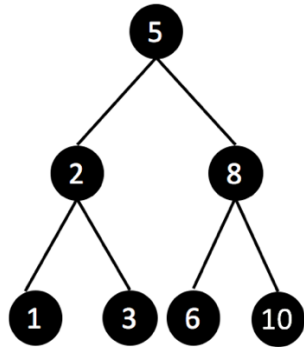
(a) Show the tree represented by this array.

95	77	88	11	45	85		
----	----	----	----	----	----	--	--

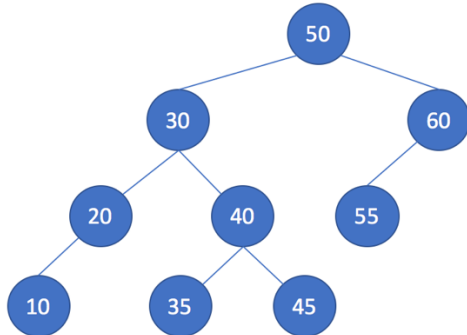
(b) Show the contents of the array after 105 is inserted into the original heap using the algorithm for insert discussed in the lecture.

(c) Show the contents of the array after delete() is executed twice on the original heap. The algorithm for delete is the same as you have seen in the lecture.

- (1) What is the maximum degree possible for a 2-3 tree? Draw the 2-3 tree that results after each of the integer keys 3, 1, 7, 2, 5, 4, 9, 6, 8, 12, 10, 11 are inserted, in that order, into an initially empty 2-3 tree. Clearly show the tree that results after each insertion, and make clear any split that must be performed.
- (6) What are the five important properties of a red-black tree? Given the following red-black tree what will be the resulting tree after you delete 3 and 10, in that order. Clearly show the tree that results after each deletion (indicating the color of each node), mention the cases you have resolved and make clear any rotations that must be performed.



- (7) What are the two important properties of an AVL tree? Given the following AVL tree. What is the resulting AVL tree after inserting 11 and then 42. Also mention the types of imbalance occurred and make clear any rotation that must be performed.



- (8) What is the limitation of binary search in an array of elements? Complete the following method for binary search of a key in a sorted array, which is sorted from smallest to largest element.

```

public static int search(int[] a, int first,
                        int size, int target) {
    int mid;
    if (size <= 0) return -1;
    else {
        mid = _____;
        if (_____) return mid;
        else if (target < a[mid])
            return search(_____);
        else
            return search(_____);
    }
}

```

- (9) Given the following sequence of elements and an empty hash table with size 11 insert the elements into the hash table. Use the **divide hash function** and **linear probing** for mapping the elements into the hash table.

50, 23, 25, 44, 35, 45, 32, 37

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]

- (10) What are problems one can face while using **open-addressing with probing** to insert elements and search for elements into a hash table? Explain with example.