CS203 B Data Structure

Quiz 2

Part 1 choices (60%)

1. Support that we have number 1 and 1000 in a binary search tree and want to search for the number 363. Which of the following sequences could not be sequence of nodes examined?
   (a) 924, 202, 911, 240, 912, 245, 363
   (b) 2, 252, 401, 398, 330, 344, 397, 363
   (c) 924, 220, 911, 244, 898, 258, 362, 363
   (d) 2, 399, 387, 219, 266, 382, 381, 278, 363

2. The following three are known to be the preorder, inorder and postorder sequences of a binary tree. But it is not known which is which.
   MBCAFHPYK
   KAMCBYPFH
   MABCKYFPH
   Pick the true statement from the following.
   (a) I and II are preorder and inorder sequences, respectively
   (b) I and III are preorder and postorder sequences, respectively
   (c) II is the inorder sequence, but nothing more can be said about the other two sequences.
   (d) II and III are the preorder and inorder sequences, respectively

3. In a min-heap stored in an array, please answer the following questions after these 11 numbers have been inserted: 12, 8, 23, 21, 6, 1, 7, 25, 24, 22, 26.
   3A. What is the value of the node at index 6? (root as index 1)
   (a) 6
   (b) 7
   (c) 22
   (d) 23
   3B. What is the value of the right child of the node with value 12?
   (a) 22
   (b) 24
   (c) 25
   (d) 26

4. Support we want to use trees to store the following 10 elements, inserted in this exact sequence: 88, 93, 76, 50, 46, 3, 32, 85, 30, 95

   4A. What is the height of the tree if we insert these 10 elements in sequence into a binary search tree?

   (a) 5

   (b) 6

   (c) 7

   (d) 8

   4B. In the binary search tree from the previous question, support we remove the node with value 76, what is the possible right child of the node with value 50?

   (a) 85

   (b) 88

   (c) 93

   (d) 95

5. Which of the following is false about a circular linked list?

   (a) Every node has a successor

   (b) Time complexity of inserting a new node at the head of the list is O(1)

   (c) Time complexity for deleting the last node is O(n)

   (d) We can traverse the whole circular linked list by starting from any point

6. How would you make the middle node of a doubly linked list to the top of the list? Let assume "x" is the middle node

   (a)
   ```
   x->RightChild->LeftChild = x->LeftChild;
   x->LeftChild->RightChild = x->RightChild;
   x->RightChild = head;
   head->LeftChild=x;
   ```

   (b)
   ```
   x->RightChild = head;
   head->LeftChild=x;
   ```

   (c)
   ```
   x->RightChild->LeftChild = x->RightChild;
   x->LeftChild->RightChild = x->LeftChild;
   x->RightChild = head;
   head->LeftChild=x;
   ```

   (d) None of these

7. The number of different binary trees with 6 nodes is?
   (a) 6
   (b) 42
   (c) 132
   (d) 256

8. A binary tree with n > 1 nodes has n1, n2 and n3 nodes of degree one, two and three respectively. The degree of a node is defined as the number of its neighbors. n3 can be expressed as
   (a) n1 + n2 - 1
   (b) n1 - 2
   (c) (n1 + n2)/2
   (d) n2 - 1

9. A binary search tree contains the values 1, 2, 3, 4, 5, 6, 7, 8. The tree is traversed in pre-order and the values are printed out. Which of the following sequences is a valid output?
   (a) 53124786
   (b) 53126487
   (c) 53241678
   (d) 53124768

10. A priority queue is implemented as a Max-heap. Initially it has 5 elements. The level order traversal of the heap is 10, 8, 5, 3, 2. Two new elements '1' and '7' are inserted into the heap in that order. The level order traversal of the heap after the insertion of the elements is
    (a) 10, 8, 7, 5, 3, 2, 1
    (b) 10, 8, 7, 2, 3, 1, 5
    (c) 10, 8, 7, 1, 2, 3, 5
    (d) 10, 8, 7, 3, 2, 1, 5

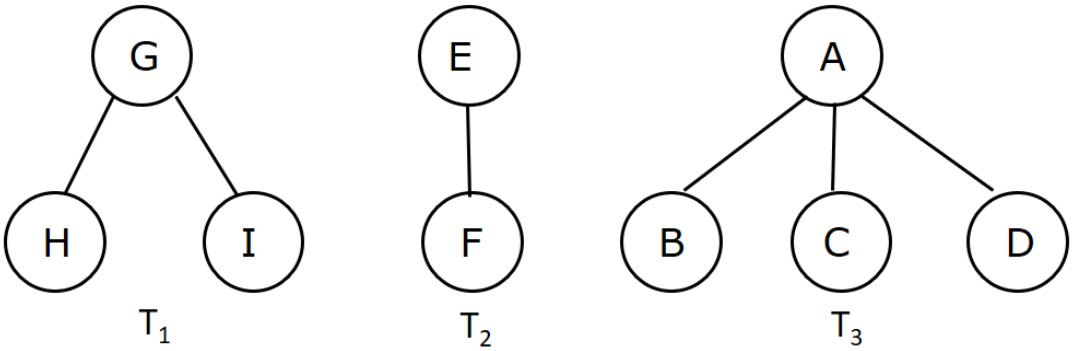
Part 2 Essay (60%)

1. Let T_B be the binary tree representation of $B(T_1,T_2,T_3)$.

   1A. What is the inorder traversal on this tree T_B? (4%)

   1B. What is the postorder traversal on this tree T_B? (4%)

   1C. What is the preorder traversal on this tree T_B? (4%)



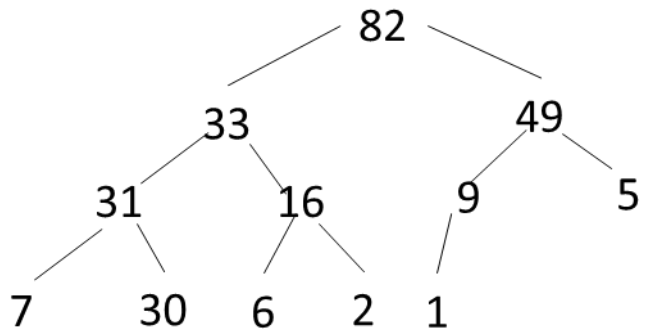
   Inorder: HIGFEBCDA

   Postorder: IHFDCBAEG

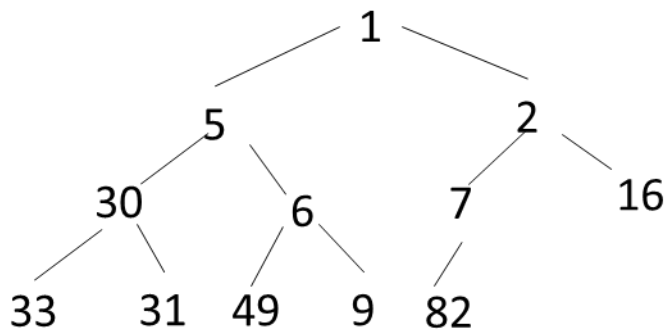
   Preorder: GHIEFABCD

2. Suppose we have the following key value:7, 9, 16, 30, 49, 82, 5, 33, 31, 6, 2, 1

   2A. Write out the max heap after each value is inserted into the heap. (3%)

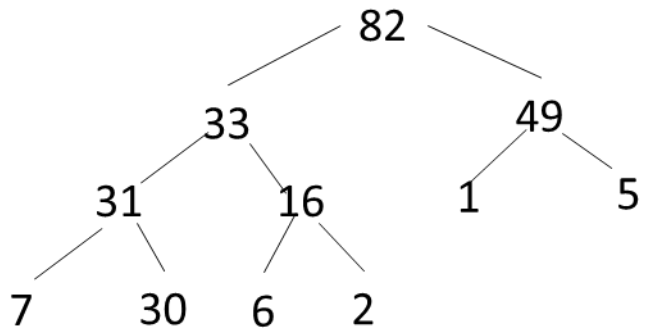


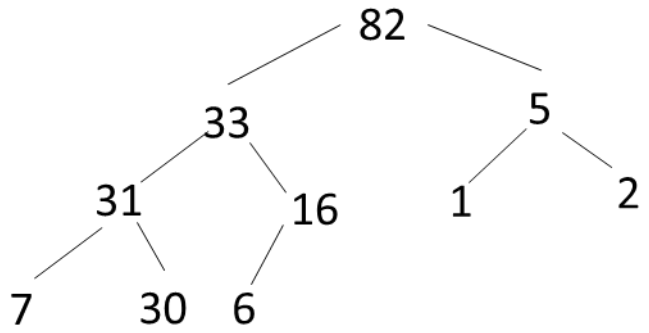
   2B. Write out the min heap after each value is inserted into the heap. (3%)



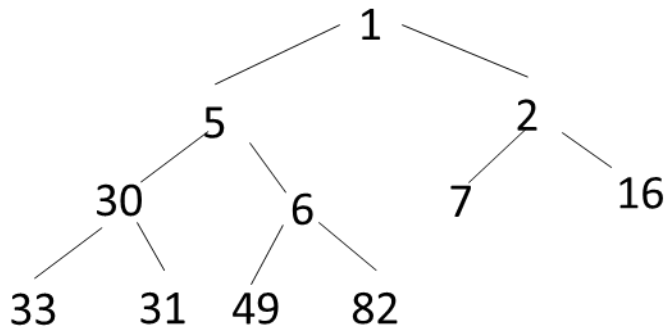
   2C. Write out the resultant max heap after deleting 9 and 49 from the max heap

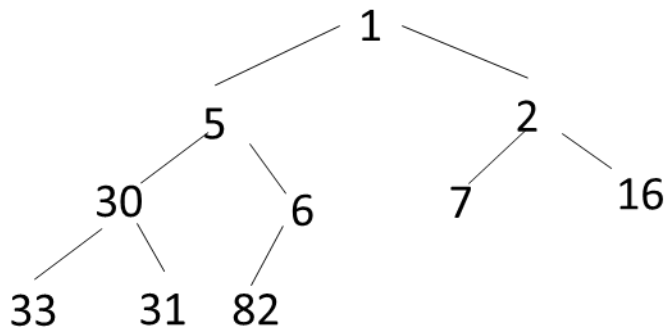
obtained in (2A) above. (3%)



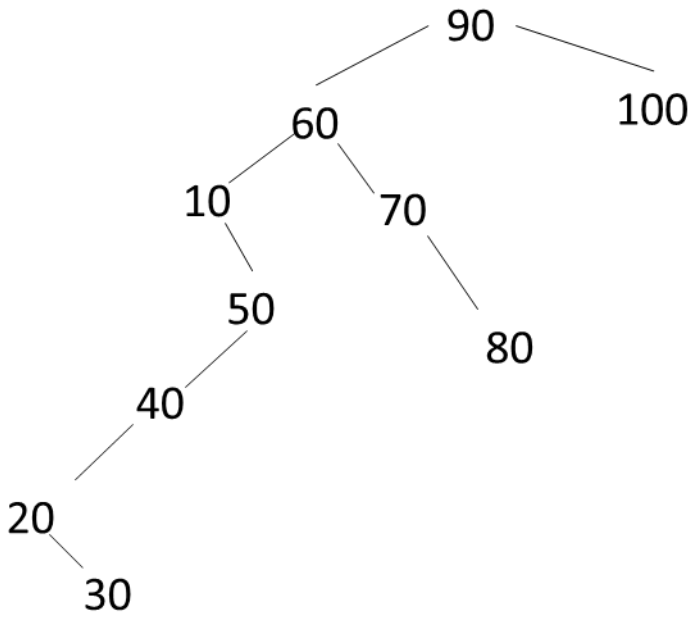


2D. Write out the resultant min heap after deleting 9 and 49 from the max heap obtained in (2B) above. (3%)





3. Suppose we have the following key value: 90, 60, 70, 100, 10, 50, 40, 20, 30, 80
   3A. Construct a binary search tree for these numbers presented given order. Please draw the resulting tree. (4%)



   3B. Please show the inorder sequence, preorder sequence, postorder sequence, respectively, of the obtained tree in (3A). (6%)

   Preorder: 90,60,10,50,40,20,30,70,80,100

   Inorder: 10,20,30,40,50,60,70,80,90,100

   Postorder:30,20,40,50,10,80,70,60,100,90

   3C. Please delete 60 from the obtained tree in (3A) and show the resulting tree. (4%)

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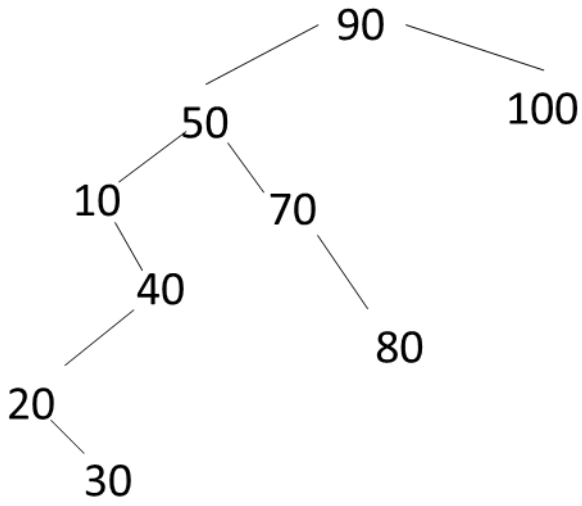
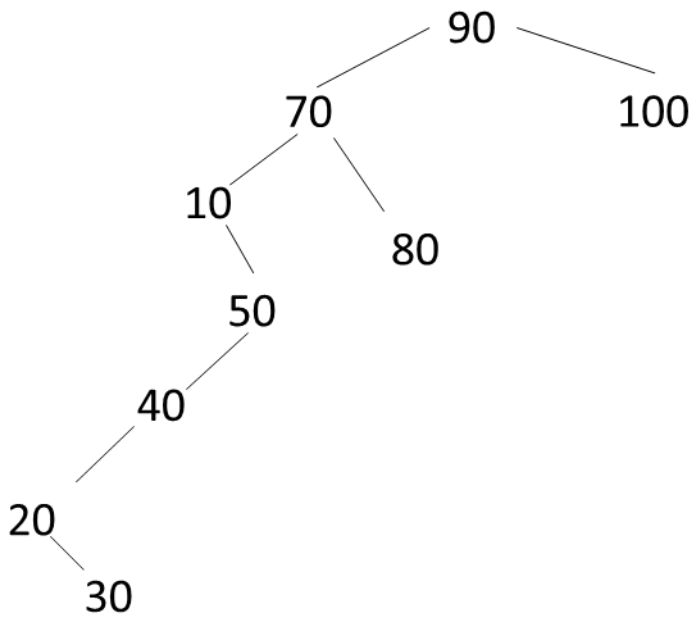
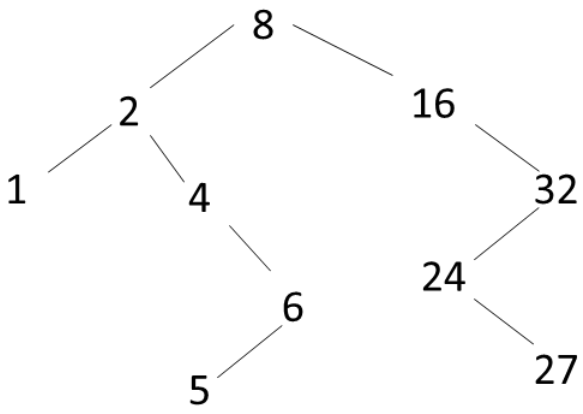




4. Given a binary search tree(BST), tree traversals have been defined: preorder, inorder, and postorder. It returns the relative position of a node in the corresponding traversal. Given the following preorder traversal of a binary search tree 8, 2, 1, 4, 6, 5, 16, 32, 24, 27. List the results of the other two traversals (6%) and draw the corresponding BST as well(6%).

   Inorder: 1, 2,4,5,6,8,16,24,27,32

   Postorder:1,5,6,4,2,27,24,32,16,8



5. For a given sequence of elements $\{A, B, C\}$, please write down its stack permutation. (10%)

   ABC；push *A*, pop *A*, push B, pop B, push C, pop C

   ACB；push *A*, pop *A*, push B, push C, pop C, pop B

   BAC；push *A*, push *B*, pop B, pop A, push C, pop C

   BCA；push *A*, push *B*, pop B, push C, pop C, pop A

   CBA；push *A*, push *B*, push C, pop C, pop B, pop A

6. Given the following declarations of the linked list with a header node, please complete the functions of insertion and deletion.

```
class DblList;
class DblListNote {
friend class DblList;
private:
        int data;
        DblListNode *llink, *rlink;
};
Class DblList {
Public:
        // List manipulation operations
Private:
        DblListNode *first; //points to head node
};
```

6A. The function to deletion from a doubly linked circular list (5%)

```
void DblList::deletion (DblListNode *x) {
        if(x == first) cerr <<"ERROR"<<endl;
        else {
                // please write the code
                (x->llink)->rlink = x->rlink;
                (x->rlink)->llink = x->llink;
                free(x);
        }
}
```

6B. The function to insert node p into a doubly linked circular list (5%)

```
void DblList::insert (DblListNode *p, DblListNode *x) {
        // insert node p to the right of node x
        p-> llink = x;
        // please write the code
        p-rlink = x->rlink
        (x->rlink)->llink = p;
        x->rlink = p
}
```

Part 3 Bonus (30%)

1. Definitions: 20%

   1A: Forest

   A forest is a set of $n \geq 0$ disjoint trees

   1B: Weighting rule

   If the number of nodes in the tree with root *i* is less than the number in the tree with root *j*, then make *j* the parent of *i* ; otherwise make *i* the parent of *j*.

   1C: Collapsing rule

   If *j* is a node on the path from *i* to its root and parent[*i*]≠ root(*i*), then set parent[*j*] to root(*i*).

   1D: Full binary tree

   A *full binary tree* of depth *k* is a binary tree of death *k* having 2^k-1 nodes, $k \geq 0$

   1E: Equivalence relation

   A relation over a set, *S*, is said to be an *equivalence relation* over *S iff* it is symmertric, reflexive, and transitive over *S*

2. Based on the Homework 3 rule, please answer the following relation. (10%)

   2A. 我(女)的丈夫的姊姊的爸爸的女兒(較年輕)的爸爸的兒子(較年長)

   夫兄

   2B. 我(女)的媽媽的媽媽的女兒(較年輕)的媽媽的女兒(較年輕)的女兒(較年長)的媽媽的兒子(較年長)

   表兄

   2C. 我的妻子的弟弟的兒子的媽媽的丈夫的哥哥的爸爸的女兒(較年長)

   妻姊

   2D. 妻子的弟弟的兒子的媽媽的丈夫的哥哥的爸爸的女兒(較年輕)的丈夫

   妻妹夫

   2E. 我(男)的女兒的哥哥的女兒的爸爸的姊姊的女兒的爸爸的妻子的爸爸

   自己