# Fall 2012: CS 3323 Final Exam

Total Time: 90 minutes Total Points: 60

Write your name clearly. Answer all the questions.

Reead all the questions. If you need more space, use the other side of your question sheet.

**Name:**_____ **Date:**_____

**Question 1. True/False** **[10]**

1. Queue ensures that the items are processed in the order they are received. T
2. Item insertion and deletion in a linked list requires significant data movement. T
3. The shortest path is the path with the smallest weight. T
4. The breadth first traversal traverses the graph from each vertex that is not visited.
5. Performance of search in an ordered Tree depends on the shape of the Tree. F
6. The value of null pointer is zero. T
7. Insertion in Red-Black Tree will give black height imbalance problem but not double red. F
8. After inserting the node in an AVL tree, the reconstruction can occur at any node on the path back to the root node. T
9. Hash table mapping scheme must be able to minimize collisions. T
10. When data is being organized, a programmer's highest priority is to organize it in such a way that item insertion, deletion, and lookups (searches) are fast. T

**Question 2. Code Analysis** **[5+5]**

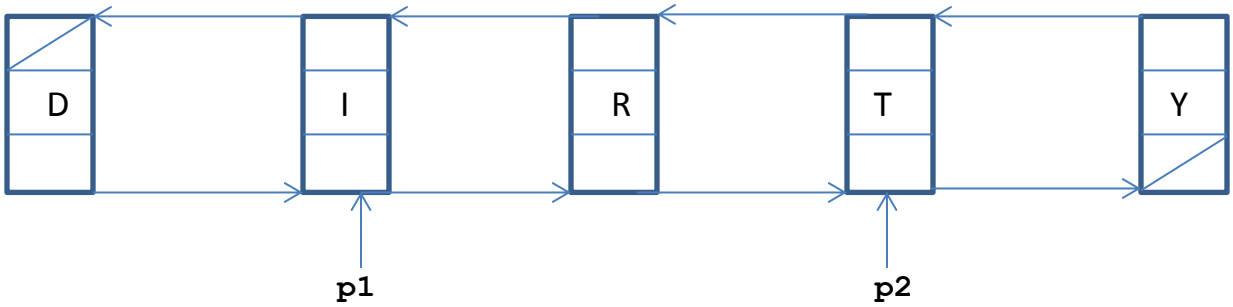
(a) For next set of problems, assume that `q` is a queue implemented by using circular arrays with **`QueueElement = char`** and **`capacity = 5.`**

**Show the value of `myFront` and `myBack` and the contents of `myArray` for the Queue object q after the program segment has been executed; also indicate any errors that occur.**

| | |
|---|---|
| `q.enqueue('A');`<br>`q.enqueue('B');`<br>`q.enqueue('C');`<br>`ch= q.front();`<br>`q.dequeue();`<br>`q.enqueue(ch);` | `myFront =` 1 `myBack =` 3<br>`myArray:` B C A |

| | |
|---|---|
| q.enqueue('X');<br>q.enqueue('Y');<br>q.enqueue('Z');<br>while(!q.empty()){<br>ch = q.front();<br>q.dequeue();<br>} | myFront = 2 myBack = 2<br>myArray: 0 |

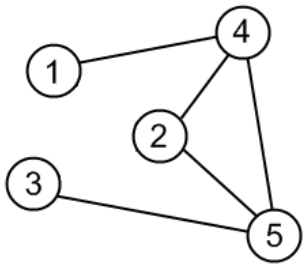
**(b) Assume the following doubly linked list with the two pointers p1 and p2:**




**Find the value of each expression.**

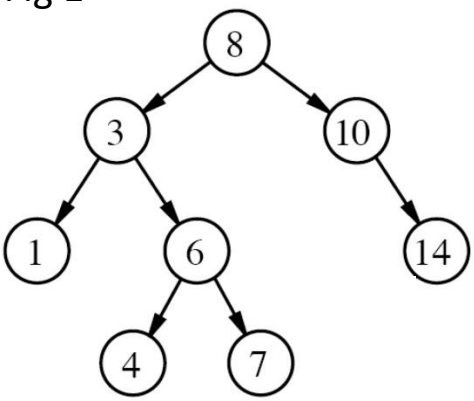
**(i)** **P1->next->data** R
**(ii)** **P1->next->next** P2
**(iii)** **P1->prev->next** P1
**(iv)** **P2->prev->prev->next->data** R
**(v)** **P2->prev->prev->prev->prev** P1

**Question 3. Give the sequence of nodes visited in (a) Depth First and (b)Breadth First Traversals on graph shown in figure below. Starting point is node 1 [4]**



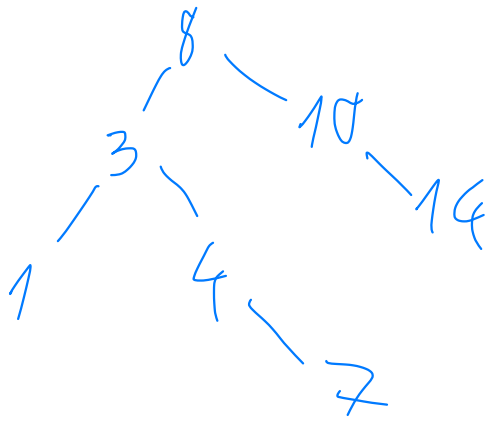
**Question 4. Draw the resulting AVL tree, in each sequence of following operations such that resulting tree follows AVL property:** **[8]**

Fig 1

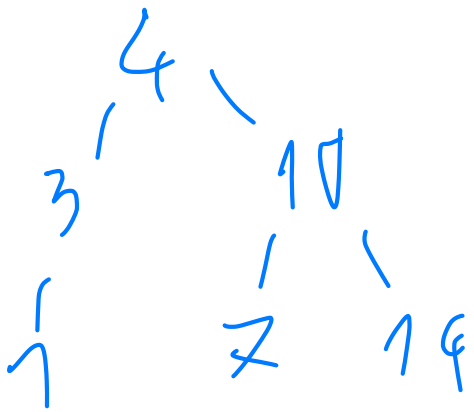



**After:**

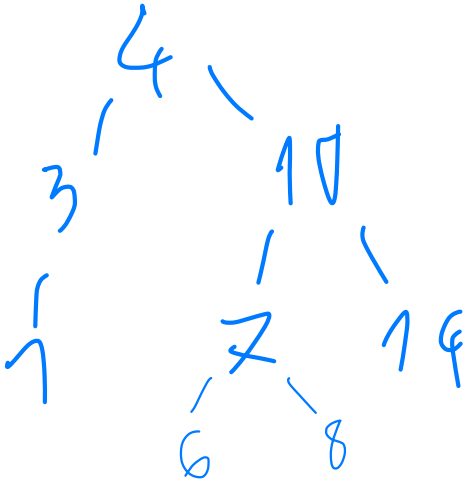
**(i). `Deleting 6`**



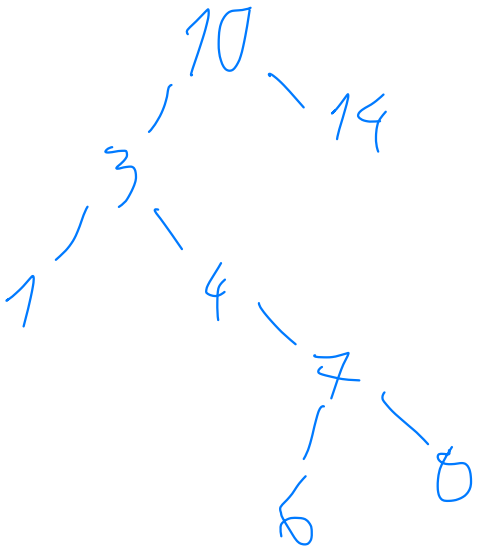

**(ii) `Deleting 8` (after i)**




**(iii) `inserting 8`(after i and ii)**




**(IV) `inserting 6` (after i, ii and iii)**

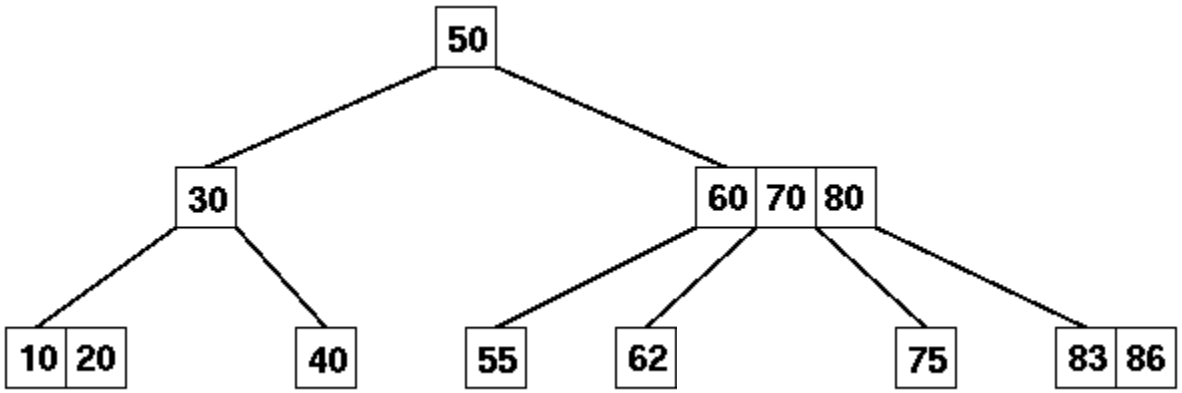


**Question 5. Provide a suitable ADT for Red-Black Tree in c++ with a suitable node structure (with a default and overloaded constructor methods) to represent this tree. [8]**

***Note: You should just provide the definition of the ADT, you do not have to provide the implementation of any methods except the constructor for the node data structure.***

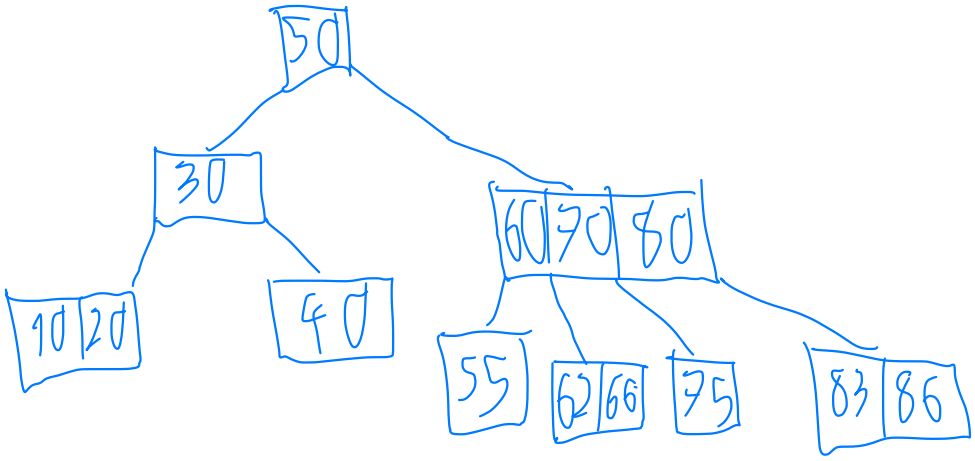
**Question 6. Describe how would you design a stack using two queues. In particular, how would you perform operation for `empty`, `top`, `push` and `pop` by using stack operations (such as `front`, `enqueue`, `dequeue` and `empty`) on these two stack. [1+1+3+3]**

**Question 7. In 2-3-4 tree below, show the tree after each of the following operations [6]**



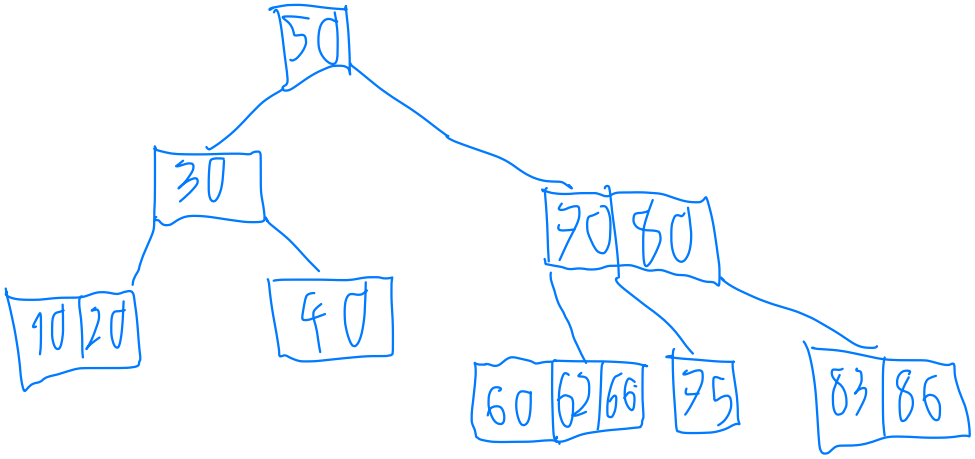

a) Insert in the original tree as shown in the figure

I. 66



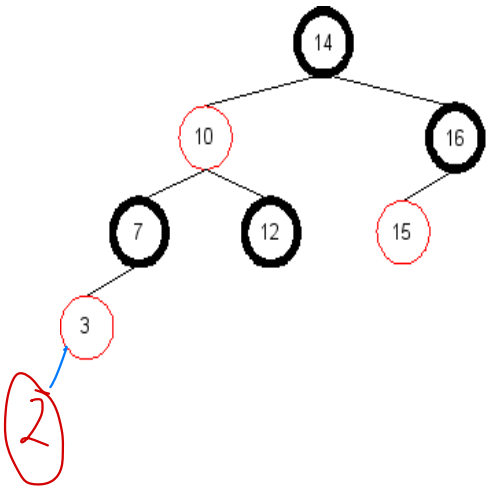

b) Delete in the original tree as shown in the figure

I. 55

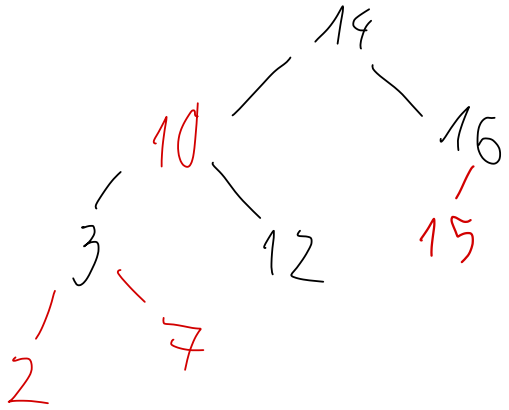



c) Convert the original 2-3-4 tree as shown in the figure into a red black tree

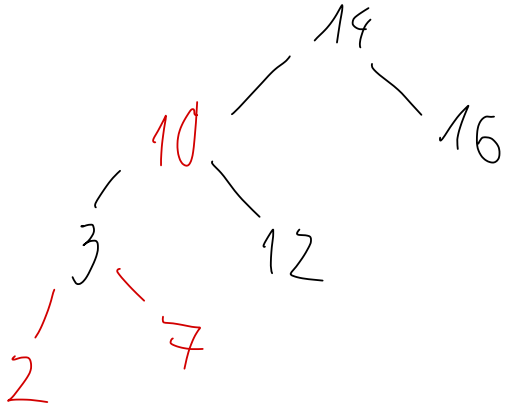
**Question 8. Observe following red black tree and show the tree after each following operations** **[6]**



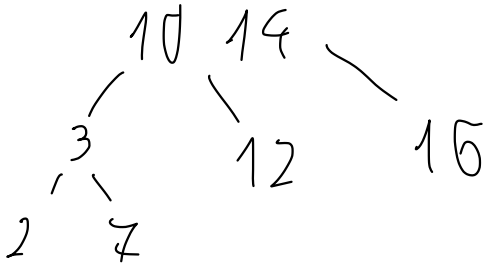

1. Insert in the original tree as shown in the figure
   I. 2




2. Delete in the original tree as shown in the figure
   a. 15




3. Convert the original red black tree as shown in the figure into a 2-3-4 tree



**Bonus Question . Provide C++ methods to compute the following in a BST that stores integer values. Prototype of the method is given as below: [6]**

**(i) Count the number of nodes**

```
int NodeCount (BinNode *node)
```

```
if (node != 0)
{ return 1 + NodeCount (node -> lchild)
           + NodeCount (node -> rchild);
}
else { return 0;}
```

**(ii) Summation of all the value stored in a BST**

```
int SumValue (BinNode *node)
```

```
if (node != 0)
{  if (node -> lchild != 0 && node -> rchild != 0)
{ return (node -> lchild -> value + node -> rchild -> value)
     + SumValue (node -> lchild -> value)
     + SumValue (node -> rchild -> value)
```

```
else if (node -> lchild != 0)
    return (node -> lchild -> value
        + SumValue (node -> lchild -> value))
else if (node -> Rchild != 0)
    return (node -> Rchild -> value
        + SumValue (node -> Rchild -> value))
else
    return 0;
```