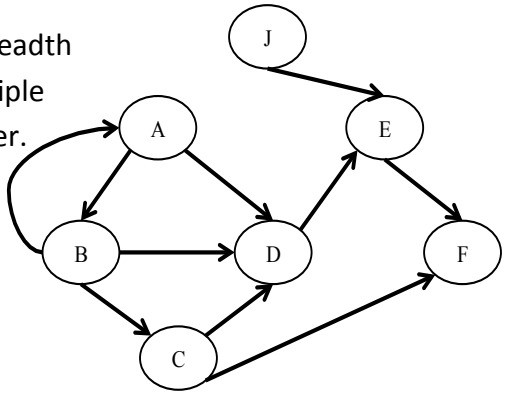
Solution

CS2223: D-Term 2017
Quiz 3

Q1: [5 Points] Given the graph on right, write down the BFS (Breadth First Search) output starting from node B. When there are multiple out-going edges from a node, process them in alphabetical order.



B, A, C, D, F, E

Q2: [4 Points] Complete the following sentence:

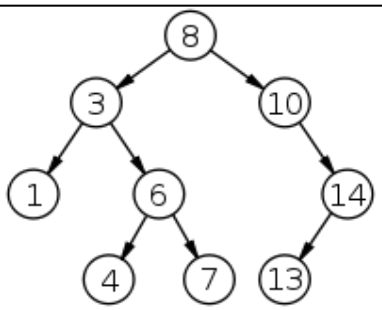
(a) Insertion in a Binary Search Tree of *N* nodes can have the best case time complexity of ….**O(1)** [Get 2 Points]....or **O(LogN)** [get 1 point]..... and worst case time complexity of .....**O(N)**.....

** For the best case, you can assume it is balanced tree and insertion is O(log n). However a more accurate answer is O(1) because independent of whether or not the tree is balanced, your insertion can be an immediate child of the root, which is O(1).

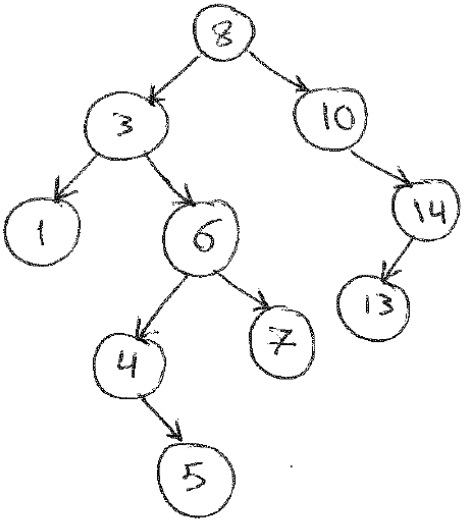
Q3: [5 Points] Given the BST on right. Show the tree after the following operations:

a) Insertion of 5 [show the tree]

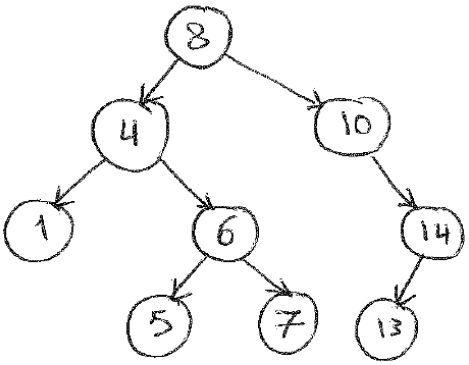
b) Deletion of 3 (after Step a is done) [Show the tree]



(a)



(b)



Q4: [5 Points] Given a binary tree **B** of *N* nodes, write a pseudocode for an efficient algorithm that decides (Just True or False) whether or not B is a *binary search tree*. Also, state the complexity of your algorithm

Algorithm 1:
- Apply in-order traversal over B
- Scan and check the output list. If sorted Then B is BST, otherwise B is NOT BST

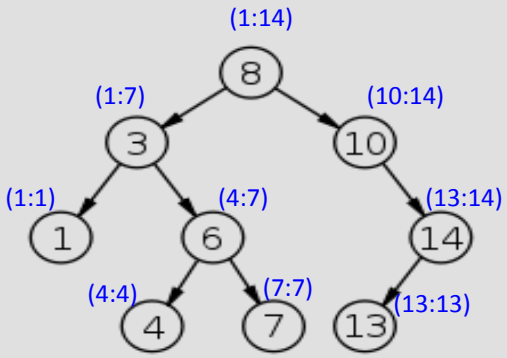
Algorithm 2:
- Apply post-order traversal, and each node will propagate bottom-up extra information to its parent as follows: Each node *w* will pass two values up (x:y), where
  x ➔ is the minimum value in w's subtree
  y ➔ is the maximum value in w's subtree

- For a leaf node *w*, the values x:y are the same and equal w's value
  (See leaf nodes in Figure)

- For a node *w* with only one L.H.S child, w.y = w's value
  and w.x = the minimum it received from its child
  (See Node 14 in Figure)

- For a node *w* with only one R.H.S child, w.x = w's value
  and w.y = the maximum it received from its child
  (See Node 10 in Figure)

- For a node *w* with two children,
  w.x = the minimum it received from its L.H.S child
  and w.y = the maximum it received from its R.H.S child
  (See Nodes 6, 3, and 8 in Figure)



- During the traversal, once a node *w* receives the info from its child (or children), it must check the BST property. That is w's value must be:
  larger than L.H.S maximum (if exists) AND smaller than the R.H.S minimum (if exists)

  If that is NOT the case ➔ Terminate and report that B is NOT binary search tree.

Algorithm 3:
- There is another algorithm that applies pre-order traversal and propagates extra information top-down instead of bottom-up. //Search online for this one.

Time complexity ➔ Any of the in-order, post-order, or pre-order traversal is O(N)