These questions are intended to assist you when studying for the exams. They are by no means a comprehensive set of all possible exam questions.

1 General Trees

1. Define tree
2. Define k-ary tree
3. For any tree, T, define the following
   (a) path in T
   (b) length of a path in T
   (c) height of a node in T
   (d) depth of a node in T
   (e) height of T
   (f) depth of T
   (g) external node
   (h) internal node
   (i) leaf
4. Given the drawing of an arbitrary tree, draw the first-child, next-sibling representation of the tree
5. Given the first-child, next-sibling representation of a tree, draw the tree.
6. Prove that there $n - 1$ edges in any tree with $n$ nodes
7. What is the worst-case big-O performance for the insert, find and remove operations in a general tree? Why is this so?
8. Write a recursive member function of the “static K-ary” tree class that counts the number of nodes in the tree.
2 Binary Trees

1. Define binary tree, full binary tree, complete binary tree and perfect binary tree.

2. Define internal path length and external path length

3. Prove that a perfect binary tree of height \( h \) has \( 2^h \) leaf nodes.

4. Prove that a perfect binary tree of height \( h \) has \( 2^{h+1} - 1 \) nodes.

5. Prove that a full binary tree with \( n \) internal nodes has \( n + 1 \) leaf nodes.

6. Prove that in any binary tree with \( n \) nodes there are \( n + 1 \) “null pointers”.

7. Suppose you have the following two traversals from the same binary tree. Draw the tree
   pre-order: A D F G H K L P Q R W Z
   in-order: G F H K D L A W R Q P Z

8. Write a recursive member function of the BinaryTree class that counts the number of nodes in the tree.

9. Write a recursive member function of the BinaryTree class that counts the number of leaves in the tree.
10. Given the following binary tree containing integers, list the output from a pre-order traversal, an in-order traversal, a post-order traversal and a level-order traversal of the tree.