1. **(2 points) Honor Code**

   I promise that I will complete this quiz independently and will not use any electronic products or paper-based materials during the quiz, nor will I communicate with other students during this quiz.

   I will not violate the Honor Code during this quiz.

   $\sqrt{}$ True   ◯ False

2. **(8 points) True or False**

   Determine whether the following statements are true or false.

   (a) (1') A perfect binary tree always has height > 0.   ◯ True $\sqrt{}$ False

   (b) (1') The minimum height of a binary tree of n nodes is $\lfloor \log_2 n \rfloor$.

   $\sqrt{}$ True   ◯ False

   (c) (1') If a binary tree of n nodes has height $\lfloor \log_2 n \rfloor$, then it is complete. ◯ True $\sqrt{}$ False

   > **Solution:** You can fill the deepest nodes from right to left.

   (d) (1') Given the pre-order and post-order traversal sequences, we can draw only one unique binary tree.   ◯ True $\sqrt{}$ False

   (e) (1') Every complete binary tree with height h ($h > 0$) has a perfect binary sub-tree with height $h - 1$.   ◯ True $\sqrt{}$ False

   > **Solution:** The solution we displayed on recitation is True, which is incorrect. Now it has been corrected.

   (f) (1') The degree and the depth of the root node are both zero in all trees. ◯ True $\sqrt{}$ False

   (g) (1') Let k is the maximum depth among all nodes, then the height of the tree is equal to $k - 1$.
   ◯ True $\sqrt{}$ False

   (h) (1') It's possible for a binary tree to have the same traversal sequences for BFS and DFS.

   $\sqrt{}$ True   ◯ False

3. **(10 points) Fill in the blanks**

   (a) (2') If T is a tree with 999 vertices, then T has _____998_____ edges.

   (b) (2') If T is a full binary tree with 50 leaves, its minimum height is _____6_____.

   (c) (2') If T is a full binary tree of height h, then the minimum number of leaves in T is _____$h + 1$_____ and the maximum number of leaves in T is _____2^h_____.

   (d) (2') Every full binary tree with 23 vertices has _____11_____ internal vertices

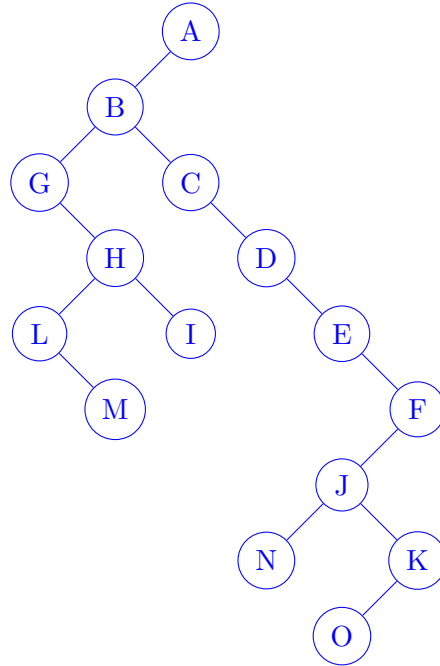   (e) (2') There are _____42_____ distinct shapes of ordered binary trees with 5 nodes.

4. **(10 points) Left-child Right-sibling binary tree**

   (a) (4') Transform the tree below with root A (in N-ary format) to LCRS format.
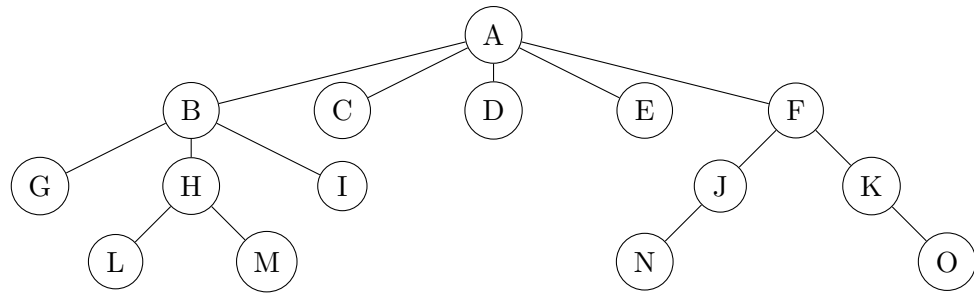
(b) (3') Is the pre-order traversal of the original tree is identical to the pre-order traversal of the Knuth transform? If the pre-order traversal of the original tree is identical to the Knuth transform, write the common sequence. If not, write both sequences separately.

Solution: Yes.
ABGHLMICDEFJNKO

(c) (3') Is the post-order traversal of the original tree is identical to the post-order traversal of the Knuth transform? If the post-order traversal of the original tree is identical to the Knuth transform, write the common sequence. If not, write both sequences separately.

Solution: No.
Post-order traversal of Original tree: GLMHIBCDENJOKFA
Post-order traversal of Knuth transform: MLIHGNOKJFEDCBA