Assignment 12

1. The number of nodes in a complete binary tree can be calculated using the formula:
   \[ N = \frac{2^h - 1}{2 - 1} \]
   where \( h \) is the height of the tree.

2. In a complete binary tree, the parent of a node with index \( i \) is the node with index \( \frac{i}{2} \).

3. The number of leaves in a complete binary tree is \( 2^h \) if \( h \) is the height of the tree.

4. The offset of a node with index \( i \) in a complete binary tree is given by \( i \).

5. In a complete binary tree, if the tree is not empty, the left sibling of a node with index \( i \) is the node with index \( i + 1 \).

6. Consider the following binary tree:
   - Root node: 1
   - Left child of root: 2
   - Right child of root: 3
   - Left child of 2: 4
   - Right child of 2: 5
   - Left child of 4: 6
   - Right child of 4: 7
   - Left child of 6: 8
   - Right child of 6: 9

   a. Draw a diagram of this binary tree.
   b. Calculate the height of this tree.
   c. Determine if the tree is complete.
   d. Find the offset of node 5.
   e. Identify the parent of node 7.

7. The level order traversal of a binary tree visits the nodes in the following order:
   - Level 1: Root node
   - Level 2: Left child of root and right child of root
   - Level 3: Left child of left child and right child of left child, left child of right child and right child of right child
   - And so on.

8. Consider the following sequence of numbers:
   1, 2, 3, 4, 5, 6, 7, 8, 9, 10

   a. Write the sequence in level order traversal order.
   b. Write the sequence in breadth-first order.
   c. Write the sequence in depth-first order (preorder).
   d. Write the sequence in depth-first order (inorder).
   e. Write the sequence in depth-first order (postorder).

9. Consider a complete binary tree with 26 nodes. Determine the height of the tree.

10. Determine whether the following statements are true or false:
    a. Every complete binary tree is a binary search tree.
    b. Every binary search tree is a complete binary tree.
    c. A binary tree can have more than one root node.
    d. A binary tree can have more than one leaves node.

11. Consider a binary tree with nodes labeled 1 through 10. Identify the root node and the leaf nodes.

12. Consider a binary tree with nodes labeled A through J. Identify the nodes labeled E and F.

13. Consider a binary tree with nodes labeled K through Z. Identify the nodes labeled X and Y.

14. Consider a binary tree with nodes labeled A through I. Identify the nodes labeled C and H.

15. Consider a binary tree with nodes labeled 1 through 10. Identify the nodes labeled 5 and 7.

16. Consider a binary tree with nodes labeled A through I. Identify the nodes labeled D and J.

17. Consider a binary tree with nodes labeled K through Z. Identify the nodes labeled M and O.

18. Consider a binary tree with nodes labeled A through I. Identify the nodes labeled B and I.

19. Consider a binary tree with nodes labeled 1 through 10. Identify the nodes labeled 2 and 8.

20. Consider a binary tree with nodes labeled A through I. Identify the nodes labeled C and K.