UNIVERSITY OF CALOOCAN CITY
COMPUTER ENGINEERING DEPARTMENT

Data Structure and Algorithm

Laboratory Activity No. 14

Tree Structure Analysis

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November 3, 2025

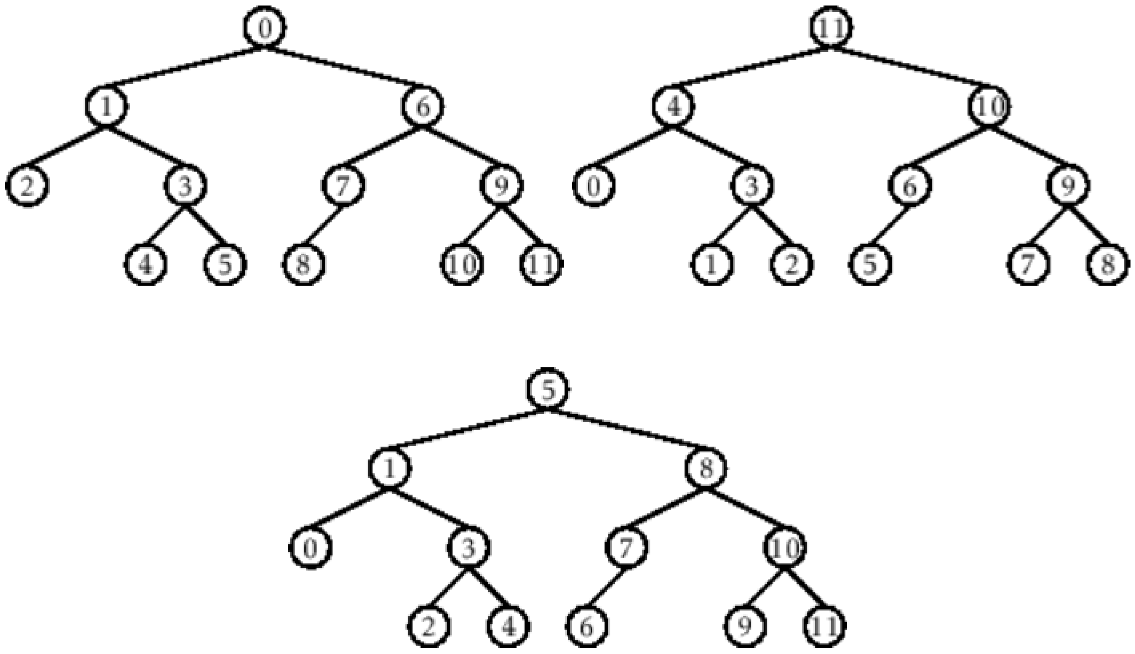
I. Objectives

Introduction

An abstract non-linear data type with a hierarchy-based structure is a tree. It is made up of links connecting nodes (where the data is kept). The root node of a tree data structure is where all other nodes and subtrees are connected to the root.

This laboratory activity aims to implement the principles and techniques in:

- To introduce Tree as Non-linear data structure
- To implement pre-order, in-order, and post-order of a binary tree



- Figure 1. Pre-order, In-order, and Post-order numberings of a binary tree

II. Methods

- Copy and run the Python source codes.
- If there is an algorithm error/s, debug the source codes.
- Save these source codes to your GitHub.
- Show the output

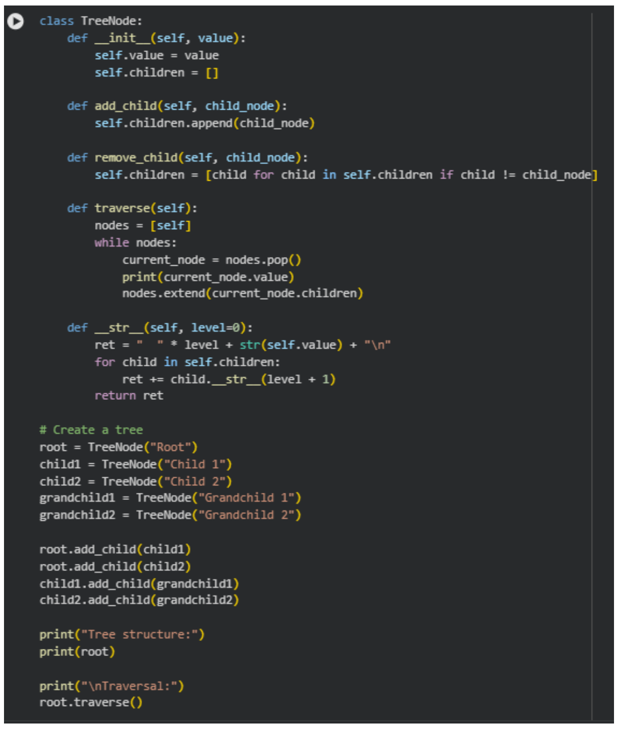
1. Tree Implementation

```
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.children = []

    def add_child(self, child_node):
        self.children.append(child_node)

    def remove_child(self, child_node):
        self.children = [child for child in self.children if child != child_node]
    def traverse(self):
        nodes = [self]
        while nodes:
            current_node = nodes.pop()
            print(current_node.value)
            nodes.extend(current_node.children)

    def __str__(self, level=0):
        ret = "  " * level + str(self.value) + "\n"
        for child in self.children:
            ret += child.__str__(level + 1)
        return ret

# Create a tree
root = TreeNode("Root")
child1 = TreeNode("Child 1")
child2 = TreeNode("Child 2")
grandchild1 = TreeNode("Grandchild 1")
grandchild2 = TreeNode("Grandchild 2")

root.add_child(child1)
root.add_child(child2)
child1.add_child(grandchild1)
child2.add_child(grandchild2)

print("Tree structure:")
print(root)

print("\nTraversal:")
root.traverse()
```

Questions:

1. What is the main difference between a binary tree and a general tree?
2. In a Binary Search Tree, where would you find the minimum value? Where would you find the maximum value?
3. How does a complete binary tree differ from a full binary tree?
4. What tree traversal method would you use to delete a tree properly? Modify the source codes.

III. Results



```python
class TreeNode:
    def __init__(self, value):
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        self.children = []

    def add_child(self, child_node):
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    def remove_child(self, child_node):
        self.children = [child for child in self.children if child != child_node]

    def traverse(self):
        nodes = [self]
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child1.add_child(grandchild1)
child2.add_child(grandchild2)

print("Tree structure:")
print(root)

print("\nTraversal:")
root.traverse()
```
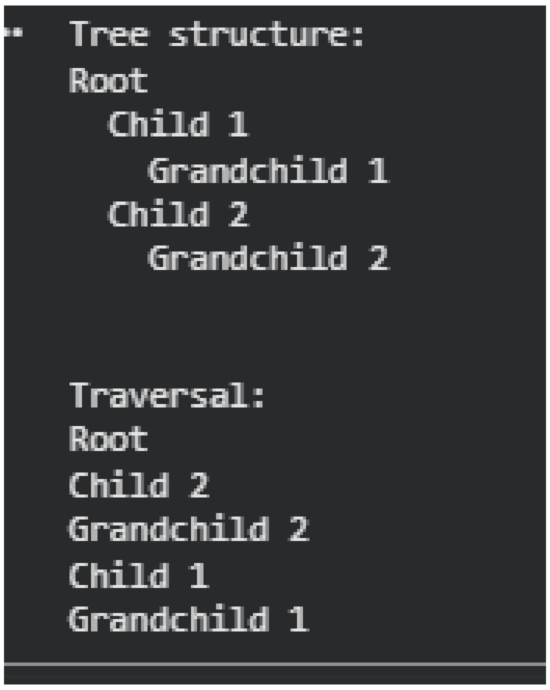

Figure 1 Source Code



```
Tree structure:
Root
  Child 1
    Grandchild 1
  Child 2
    Grandchild 2


Traversal:
Root
Child 2
Grandchild 2
Child 1
Grandchild 1
```

Figure 2 Output

1. What is the main difference between a binary tree and a general tree?

- A binary tree can only have up to two children per node left and right. A general tree can have any number of children. There is no limit.

2. In a Binary Search Tree, where would you find the minimum value? Where would you find the maximum value?

- The minimum value is found by going all the way to the left child. The maximum value is found by going all the way to the right child.

3. How does a complete binary tree differ from a full binary tree?

- A full binary tree means every node has either 0 or 2 children. No node has only 1 child. A complete binary tree means all levels are filled, except maybe the last, and nodes are placed from left to right.

4. What tree traversal method would you use to delete a tree properly? Modify the source codes.

- To delete a tree properly, I would use post-order traversal. This deletes children first before deleting the parent, so nothing is left hanging.

Source Code:

```
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.children = []

    def add_child(self, child_node):
        self.children.append(child_node)

    def remove_child(self, child_node):
        self.children = [child for child in self.children if child != child_node]

    def traverse(self):
        nodes = [self]
        while nodes:
            current_node = nodes.pop()
            print(current_node.value)
            nodes.extend(current_node.children)

    # Post-order delete
    def delete_tree(self):
        for child in self.children:
            child.delete_tree()
        print(f"Deleting node: {self.value}")
        self.children = []

    def __str__(self, level=0):
        ret = "  " * level + str(self.value) + "\n"
        for child in self.children:
            ret += child.__str__(level + 1)
        return ret

# Create a tree
root = TreeNode("Root")
child1 = TreeNode("Child 1")
child2 = TreeNode("Child 2")
grandchild1 = TreeNode("Grandchild 1")
grandchild2 = TreeNode("Grandchild 2")
```

```
root.add_child(child1)
root.add_child(child2)
child1.add_child(grandchild1)
child2.add_child(grandchild2)

print("Tree structure:")
print(root)

print("\nDeleting Tree:")
root.delete_tree()
```

IV. Conclusion

In this laboratory activity, I was able to understand how a tree works as a non linear data structure. I learned how nodes are connected and how the root serves as the main starting point of all other nodes. I also practiced the different tree traversal methods such as pre order, in order, and post order. By doing these, I became more familiar with how data is organized in a tree and how each traversal gives a different way of visiting the nodes. Overall, this activity helped me understand the concept of trees better and improved my skills in working with hierarchical structures.