DSA Week 16 activities

This week, you are required to complete two questionnaires and two labs.

a. In this print out, answer all Week 16 questions.
b. Also, in this print out, complete Week 16 lab 1 & 2 using the lab computers.

Note: You can complete the activities in any order, however, make afford to complete and understand everything which prepares you for well for the Final Exam.

DSA Week 16 Questions

1. Differentiate between a general tree and a binary tree data structure.

A general tree is an abstract data type that stores elements hierarchically. With the exception of the top element, each element in a tree has a parent element and zero or more children elements.

A general tree and binary tree ADTs are non-linear data structures. The tree ADT is similar to Linked Lists because each node contains data and can be linked to other nodes.

A tree T as a set of nodes storing elements such that the nodes have a parent-child relationship that satisfies the following properties: If T is nonempty, it has a special node, called the root of T, that has no parent. Each node v of T different from the root has a unique parent node w; every node with parent w is a child of w.

A binary tree is a type of tree ADT where each node can have a maximum of two child nodes, a left child node and a right child node.

A binary tree is an ordered tree with the following properties: Every node has at most two children. Each child node is labeled as being either a left child or a right child. A left child precedes a right child in the order of children of a node.

2. Discuss a real-world application of a tree ADT in computing.

Used in file systems – operating systems use tree structure to manage, navigate, organise and manipulate directories and files.

Website through the use of Document Object Model (DOM) where webpages in html format are organised hierarchy.

Company hierarchies where organisations charts are model as trees representing company structure and report roles in the organisation.

3. Discuss any two methods used with the tree ADT.

- root( ): Returns the position of the root of the tree (or null if empty)
- parent(p): Returns the position of the parent of position p (or null if p is the root).
- children(p): Returns an iterable collection containing the children of position p (if any).
- numChildren(p): Returns the number of children of position p.

- isInternal(p): Returns true if position p has at least one child.
- isExternal(p): Returns true if position p does not have any children.
- isRoot(p): Returns true if position p is the root of the tree.
- size( ): Returns the number of positions (and hence elements) that are contained in the tree.
- isEmpty( ): Returns true if the tree does not contain any positions (and thus no elements).
- iterator( ): Returns an iterator for all elements in the tree (so that the tree itself is Iterable).
- positions( ): Returns an iterable collection of all positions of the tree

4. Explain the terms child node, parent node, root node, internal node, external nodes, leaves node and siblings node?

In a tree Abstract Data Type (ADT), the following terms define different types of nodes within the structure:

- **Child Node**: A node that originates from another node (its parent). Every node in a tree, except the root, has a parent.
- **Parent Node**: A node that has one or more child nodes connected to it. It establishes hierarchical relationships within the tree.
- **Root Node**: The topmost node of the tree that serves as the starting point. It does not have a parent.
- **Internal Node**: A node that has at least one child, meaning it is not an endpoint of the tree.
- **External Node (Leaf Node)**: A node that does not have any children, making it an endpoint or terminal node.
- **Sibling Nodes**: Nodes that share the same parent, meaning they exist at the same hierarchical level under a common ancestor.

DSA Week 16 Lab Activity (Week11Lab1)

Using the lab computers create the following Java program using jGrasp!

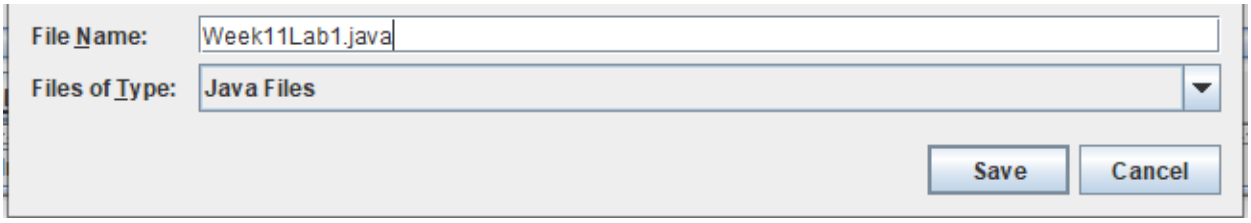
Step 1: Login to your lab computer and create a new java file in jGrasp.

Step 2: When the window below appears. Type the following code into jGrasp.

```
1  /* DSA Week 11 Lab 1 */
2
3  //import Arraylist and list classes
4  import java.util.ArrayList;
5  import java.util.List;
6
7  class TreeNode {
8      String value;
9      List<TreeNode> children;
10
11     TreeNode(String value) {
12         this.value = value;
13         this.children = new ArrayList<>();
14     }
15
16     void addChild(TreeNode child) {
17         children.add(child);
18     }
19 }
20
21 public class Week11Lab1 {
22
23     static void printTree(TreeNode node, int level) {
24         // Indent based on tree level
25         for (int i = 0; i < level; i++) {
26             System.out.print("    ");
27         }
28
29         System.out.println(node.value);
30
31         for (TreeNode child : node.children) {
32             printTree(child, level + 1);
33         }
34     }
35
```

```
36      public static void main(String[] args) {
37          // Create the root node
38          TreeNode root = new TreeNode("Diploma Programs");
39
40          // Add children in the same order as stack push
41          TreeNode node1 = new TreeNode("DIT");
42          root.addChild(node1);
43
44          TreeNode child1 = new TreeNode("D1");
45          node1.addChild(child1);
46
47          TreeNode child2 = new TreeNode("D2");
48          node1.addChild(child2);
49
50          TreeNode node2 = new TreeNode("DHRM");
51          root.addChild(node2);
52
53          TreeNode node3 = new TreeNode("DACC");
54          root.addChild(node3);
55
56          TreeNode node4 = new TreeNode("DICT");
57          root.addChild(node4);
58
59          // Print tree recursively
60          printTree(root, 0);
61      }
62  }
```

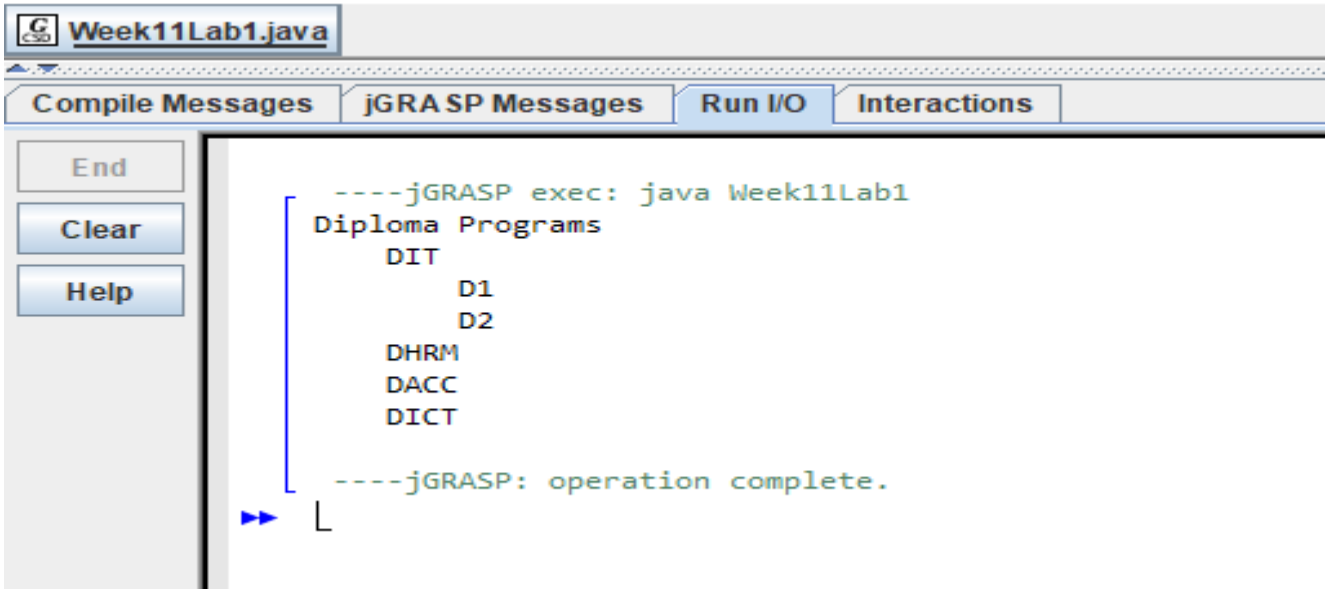
Step 3: Go to **file/save** to save your java program as **Week11Lab1**



Step 4: After saving, compile (**click on compile icon or on your keyword hold Ctrl + B**) to check for syntax errors.

Step 5: If compiling is successfully then run (**click on the find and run main method icon or on your keyboard hold Ctrl + R**) your program.

Step 6: If run is successful then you should see the following output in the console



Step 7: Week11Lab1 Completed! You have created your first tree data structure program.

DSA Week 16 Lab Activity (Week11Lab2)

Using the lab computers create the following Java program using jGrasp!

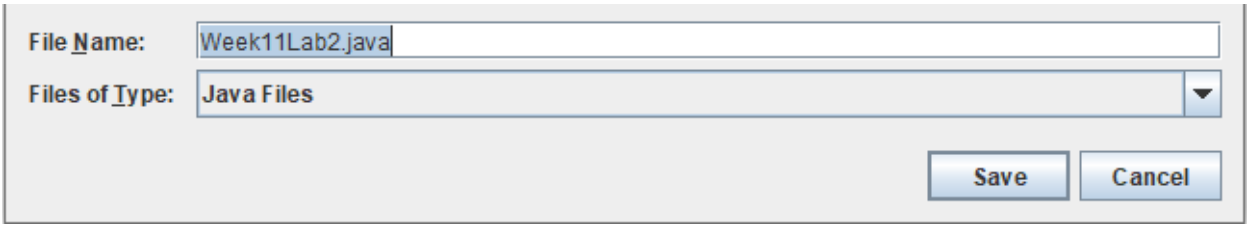
Step 1: Login to your lab computer and create a new java file in jGrasp.

Step 2: Now, type the following code into jGrasp.

```
/* DSA Week 11 Lab 2 */

class BinaryTreeNode {
    String value;
    BinaryTreeNode left;   // First child
    BinaryTreeNode right;  // Next sibling

    BinaryTreeNode(String value) {
        this.value = value;
        this.left = null;
        this.right = null;
    }

    //method to add child using left-child right-sibling nodes
    void addChild(BinaryTreeNode child) {
        if (left == null) {
            left = child;
        } else {
            BinaryTreeNode current = left;
            while (current.right != null) {
                current = current.right;
            }
            current.right = child;
        }
    }
}

public class Week11Lab2 {

    //printTree method for binary tree using left-child right-sibling
    static void printTree(BinaryTreeNode node, int level) {
        if (node == null) return;

        // Indentation loop
        for (int i = 0; i < level; i++) {
            System.out.print("    ");
        }
        System.out.println(node.value);

        // First child (left) goes to next level
        printTree(node.left, level + 1);

        // Sibling (right) stays on same level
        printTree(node.right, level);
    }

```

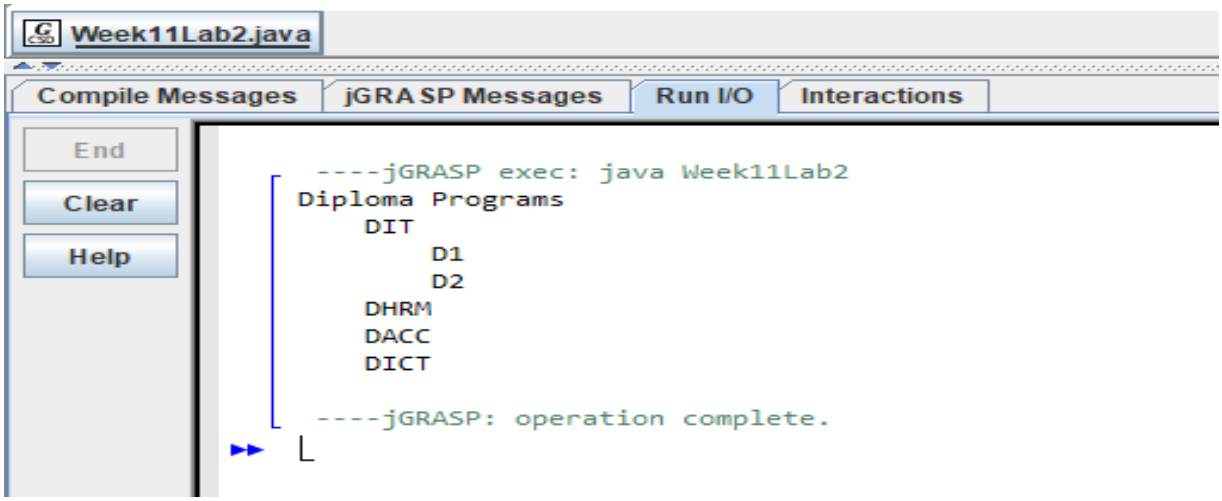
```
47      public static void main(String[] args) {
48          // Create root
49          BinaryTreeNode root = new BinaryTreeNode("Diploma Programs");
50
51          // Add children to root
52          BinaryTreeNode dit = new BinaryTreeNode("DIT");
53          BinaryTreeNode dhrm = new BinaryTreeNode("DHRM");
54          BinaryTreeNode dacc = new BinaryTreeNode("DACC");
55          BinaryTreeNode dict = new BinaryTreeNode("DICT");
56
57          root.addChild(dit);
58          root.addChild(dhrm);
59          root.addChild(dacc);
60          root.addChild(dict);
61
62          // Add children to DIT (first one)
63          dit.addChild(new BinaryTreeNode("D1"));
64          dit.addChild(new BinaryTreeNode("D2"));
65
66          // Print the binary tree
67          printTree(root, 0);
68      }
69  }
```

Step 3: After coding the program, go to **file/save** to save your java program as **Week11Lab2**



Step 4: After saving, compile (**click on compile icon or on your keyword hold Ctrl + B**) to check for syntax errors.

Step 5: If compiling is successfully then run (**click on the find and run main method icon or on your keyboard hold Ctrl + R**) your program.



Step 6: If successful your program should display an output like shown in the screenshot above.

Step 7: Week11Lab2 Completed! You have created your first binary tree data structure program.