Day 7&8

Task 1: Balanced Binary Tree Check
Write a function to check if a given binary tree is balanced. A balanced tree is one where the height of two subtrees of any node never differs by more than one.

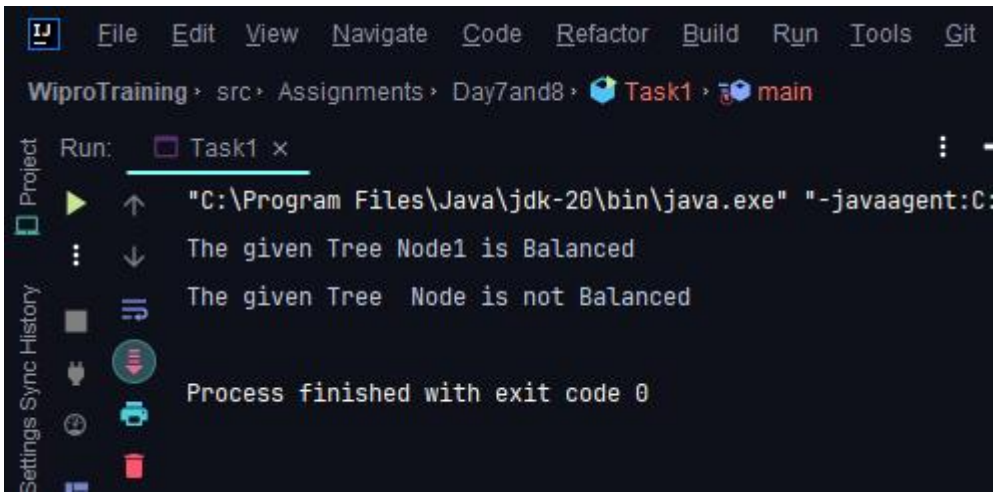
Program:

```
public class TreeNode {
   int val;
   TreeNode left;
   TreeNode right;
   TreeNode(){}
   TreeNode(int val){
      this.val = val;
   }
   TreeNode(int val, TreeNode left, TreeNode right){
      this.val = val;
      this.left = left;
      this.right = right;
   }
}
```

```
package Assignments.Day7and8;

public class Task1 {
   private static boolean isBalanced(TreeNode root){
      if(root == null) return true;
      return height(root) >= 0;
   }

   private static int height(TreeNode root) {
      if(root == null)return 0;
      int left = height(root.left);
      int right = height(root.right);
      if(left == -1 || right == -1) return -1;
      if(Math.abs(left -right) > 1) return -1;
      return 1+Math.max(left,right);
   }

   public static void main(String[] args) {
```

```
        TreeNode node = new TreeNode(1);
        node.left = new TreeNode(2);
        node.right = new TreeNode(2);
        node.left.left = new TreeNode(3);
        node.left.right = new TreeNode(3);
        node.left.left.left = new TreeNode(4);
        node.left.left.right = new TreeNode(4);

        TreeNode node1 =new TreeNode(3);
        node1.left = new TreeNode(9);
        node1.right = new TreeNode(20);
        node1.right.left = new TreeNode(7);
        node1.right.right = new TreeNode(15);

        if(isBalanced(node1)){
            System.out.println("The given Tree Node1 is Balanced");
        }else
            System.out.println("The given Tree Node1 is not Balanced");
        if(isBalanced(node)){
            System.out.println("The given Tree Node is Balanced");
        }else
            System.out.println("The given Tree  Node is not Balanced");
    }
}
```

Output:



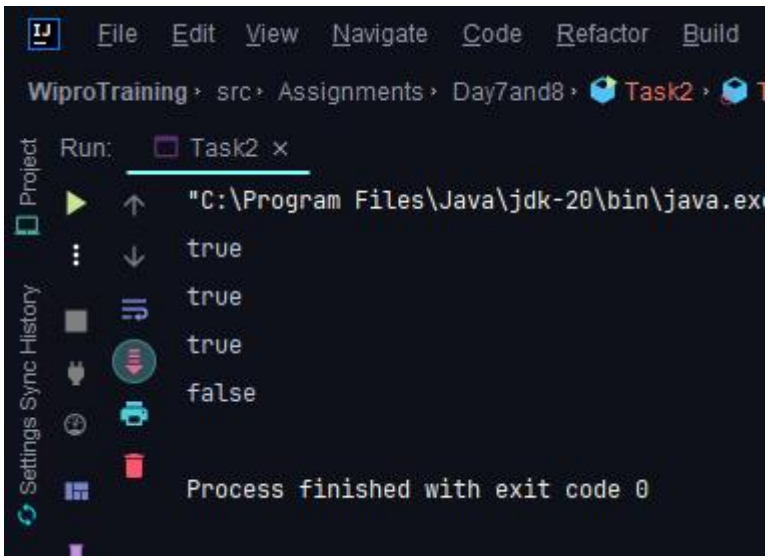
Task 2: Trie for Prefix Checking
Implement a trie data structure in java that supports insertion of strings and provides a method to check if a given string is a prefix of any word in the trie.

Program:

```
package Assignments.Day7and8;

import java.util.HashMap;
import java.util.Map;

public class Task2 {

    private TrieNode root;

    public Task2() {
        root = new TrieNode();
    }

    private static class TrieNode {
        private Map<Character, TrieNode> children;
        private boolean isWord;

        public TrieNode() {
            children = new HashMap<>();
            isWord = false;
        }
    }

    public void insert(String word) {
        TrieNode cur = root;
        for (int i = 0; i < word.length(); i++) {
            char ch = word.charAt(i);
            TrieNode node = cur.children.get(ch);
            if (node == null) {
                node = new TrieNode();
                cur.children.put(ch, node);
            }
            cur = node;
        }
        cur.isWord = true;
    }

    public boolean isPrefix(String prefix) {
        TrieNode current = root;
```

```
        for (int i = 0; i < prefix.length(); i++) {
            char ch = prefix.charAt(i);
            TrieNode node = current.children.get(ch);
            if (node == null) {
                return false;
            }
            current = node;
        }
        return true;
    }



    public static void main(String[] args) {
        Task2 trie = new Task2();
        trie.insert("apple");
        trie.insert("banana");
        trie.insert("cherry");

        System.out.println(trie.isPrefix("app"));  // true
        System.out.println(trie.isPrefix("ban"));  // true
        System.out.println(trie.isPrefix("che"));  // true
        System.out.println(trie.isPrefix("dog")); // false
    }
}
```

Output:



Task 3: Implementing Heap Operations
Code a min-heap in C# with methods for insertion, deletion, and fetching the minimum element. Ensure that the heap property is maintained after each operation.

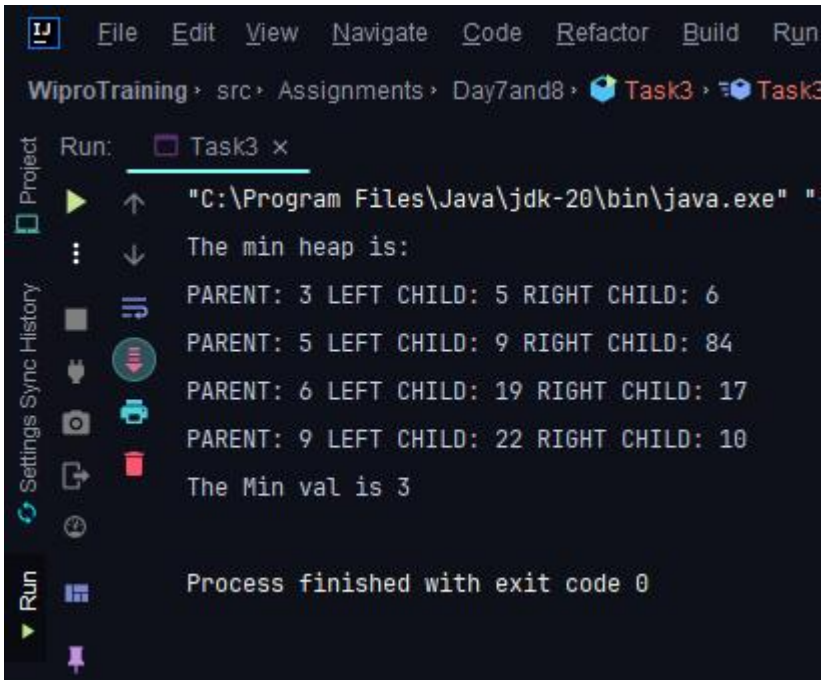
Program:

```
package Assignments.Day7and8;

public class Task3 {
    private final int[] heap;
    private int size;
    private final int maxSize;

    private static final int FRONT = 1;

    public Task3(int maxSize) {
        this.maxSize = maxSize;
        this.size = 0;
        heap = new int[this.maxSize + 1];
        heap[0] = Integer.MIN_VALUE;
    }

    public static void main(String[] args) {
        System.out.println("The min heap is: ");
        Task3 minHeap = new Task3(15);
        minHeap.insert(5);
        minHeap.insert(3);
        minHeap.insert(17);
        minHeap.insert(10);
        minHeap.insert(84);
        minHeap.insert(19);
        minHeap.insert(6);
        minHeap.insert(22);
        minHeap.insert(9);

        minHeap.display();

        System.out.println("The Min val is " + minHeap.remove());
    }

    private int remove() {
        int pop = heap[FRONT];
        heap[FRONT] = heap[size--];
        minElement(FRONT);
```

```
        return pop;
    }


    private void minElement(int position) {
        if (!isLeaf()){
            int swapPosition;

            if (rightChild(position)<= size){
                swapPosition                                                    =
heap[leftChild(position)]<heap[rightChild(position)]?leftChild(position):
rightChild(position);
            }else {
                swapPosition = leftChild(position);
            }
            if (heap[position] > heap[leftChild(position)] || heap[position]>
heap[rightChild(position)]){
                swap(position,swapPosition);
                minElement(swapPosition);
            }
        }
    }

    private int leftChild(int position) {
        return 2*position;
    }

    private int rightChild(int position) {
        return 2*position + 1;
    }

    private boolean isLeaf() {
        return FRONT > size / 2;
    }

    private void display() {
        for (int i = 1; i <= size/2; i++) {
            System.out.print("PARENT: " + heap[i] + " LEFT CHILD: " +
heap[2*i] + " RIGHT CHILD: "+ heap[2*i+1]);
            System.out.println();
        }
    }

    private void insert(int n) {
        if(size >= maxSize){
            return;
```

```
        }
        heap[++size] = n;
        int cur = size;
        while(heap[cur] < heap[parent(cur)]){
            swap(cur, parent(cur));
            cur = parent(cur);

        }

    }
    private void swap(int a, int b){
        int temp = heap[a];
        heap[a] = heap[b];
        heap[b] = temp;
    }
    private int parent(int position) {
        return position/2;
    }
}
```

Output:



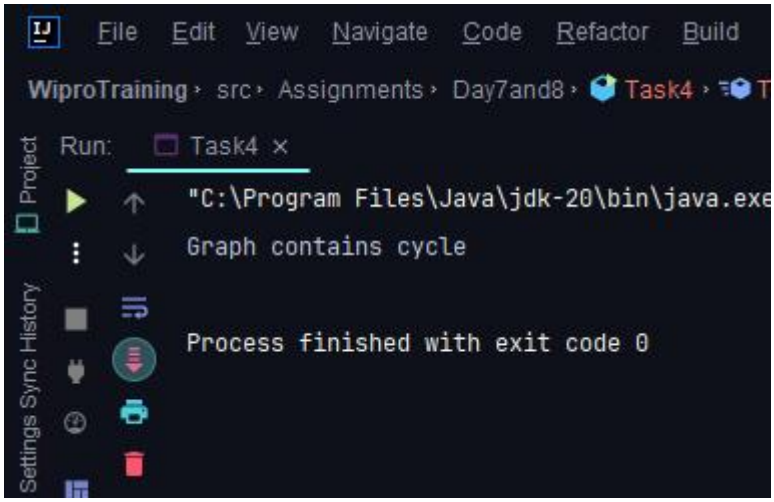
Task 4: Graph Edge Addition Validation
Given a directed graph, write a function that adds an edge between two nodes and then checks if the graph still has no cycles. If a cycle is created, the edge should not be added.

Program:

```
package Assignments.Day7and8;

import java.util.ArrayList;
import java.util.LinkedList;
import java.util.List;

public class Task4 {
   private final int V;
   private final List<List<Integer>> adj;

   public Task4(int V)
   {
      this.V = V;
      adj = new ArrayList<>(V);

      for (int i = 0; i < V; i++)
         adj.add(new LinkedList<>());
   }
   private boolean isCyclicUtil(int i, boolean[] visited,
                           boolean[] recStack)
   {

      if (recStack[i])
         return true;

      if (visited[i])
         return false;

      visited[i] = true;

      recStack[i] = true;
      List<Integer> children = adj.get(i);

      for (Integer c : children)
         if (isCyclicUtil(c, visited, recStack))
            return true;
      recStack[i] = false;
```

```
        return false;
    }

    private void addEdge(int source, int dest)
    {
        adj.get(source).add(dest);
    }

    private boolean isCyclic()
    {
        boolean[] visited = new boolean[V];
        boolean[] recStack = new boolean[V];

        for (int i = 0; i < V; i++)
            if (isCyclicUtil(i, visited, recStack))
                return true;

        return false;
    }
    public static void main(String[] args) {
        Task4 graph = new Task4(4);
        graph.addEdge(0, 1);
        graph.addEdge(0, 2);
        graph.addEdge(1, 2);
        graph.addEdge(2, 0);
        graph.addEdge(2, 3);
        graph.addEdge(3, 3);

        // Function call
        if (graph.isCyclic())
            System.out.println("Graph contains cycle");
        else
            System.out.println("Graph doesn't "
                    + "contain cycle");
    }
}
```

Output:



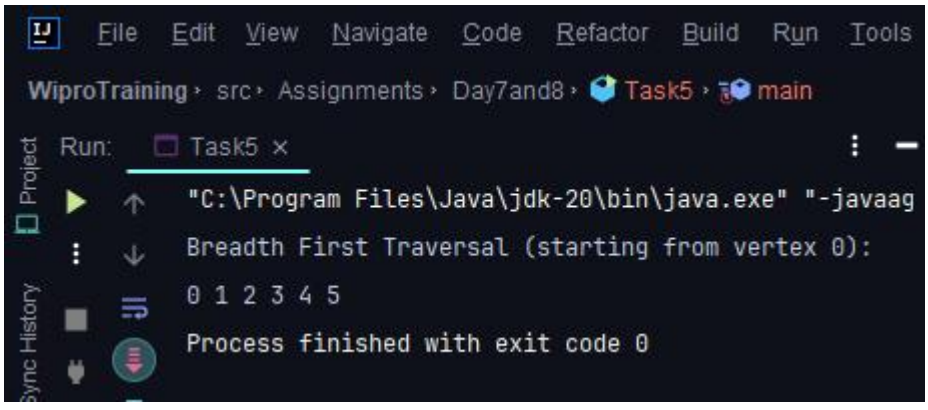
Task 5: Breadth-First Search (BFS) Implementation
For a given undirected graph, implement BFS to traverse the graph starting from a given node and print each node in the order it is visited.

Program:

```
package Assignments.Day7and8;
import java.util.*;

class Task5 {
    private int V;
    private LinkedList<Integer>[] adj;

    public Task5(int v) {
        V = v;
        adj = new LinkedList[v];
        for (int i = 0; i < v; ++i) {
            adj[i] = new LinkedList<>();
        }
    }

    public void addEdge(int v, int w) {
        adj[v].add(w);
        adj[w].add(v);
    }

    public void BFS(int start) {
        boolean[] visited = new boolean[V];
        Queue<Integer> queue = new LinkedList<>();
        visited[start] = true;
```

```
        queue.add(start);

        while (!queue.isEmpty()) {
            int current = queue.poll();
            System.out.print(current + " ");
            for (int next : adj[current]) {
                if (!visited[next]) {
                    visited[next] = true;
                    queue.add(next);
                }
            }
        }
    }

    public static void main(String[] args) {

        Task5 graph = new Task5(6);
        graph.addEdge(0, 1);
        graph.addEdge(0, 2);
        graph.addEdge(1, 3);
        graph.addEdge(2, 4);
        graph.addEdge(3, 5);

        System.out.println("Breadth First Traversal (starting from vertex 0):");

        graph.BFS(0);
    }
}
```

Output:



Task 6: Depth-First Search (DFS) Recursive
Write a recursive DFS function for a given undirected graph. The function should visit every node and print it out.

Program:

```
package Assignments.Day7and8;

import java.util.*;

class Task6 {
    private int V;
    private final LinkedList<Integer>[] adj; // Adjacency list

    public Task6(int v) {
        V = v;
        adj = new LinkedList[v];
        for (int i = 0; i < v; ++i) {
            adj[i] = new LinkedList<>();
        }
    }


    public void addEdge(int v, int w) {
        adj[v].add(w);
        adj[w].add(v);
    }


    private void DFSUtil(int v, boolean[] visited) {
        visited[v] = true;
        System.out.print(v + " ");

        for (int next : adj[v]) {
            if (!visited[next]) {
                DFSUtil(next, visited);
            }
        }
    }

    public void DFS(int v) {
        boolean[] visited = new boolean[V];
        DFSUtil(v, visited);
    }
```

```
    public static void main(String[] args) {
        Task6 graph = new Task6(4);
        graph.addEdge(0, 1);
        graph.addEdge(0, 2);
        graph.addEdge(1, 2);
        graph.addEdge(2, 0);
        graph.addEdge(2, 3);
        graph.addEdge(3, 3);

        System.out.println("Depth First Traversal (starting from vertex 2):");
        graph.DFS(2);
    }
}
```

Output: