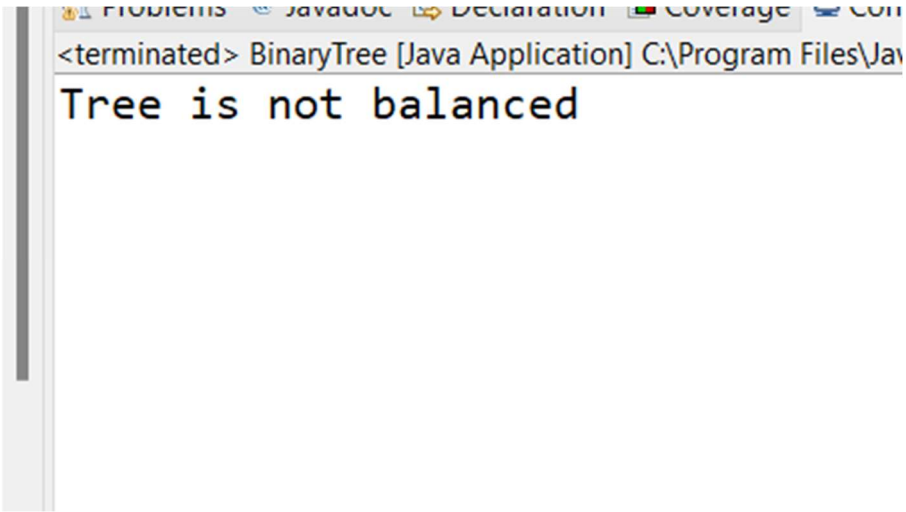
Day 7 and 8:
Task 1: Balanced Binary Tree Check
Write a function to check if a given binary tree is balanced. A balanced tree is one where the height of two subtrees of any node never differs by more than one.

```
package com.dsassignment.day7;

class Node {
    int data;
    Node left, right;

    Node(int item) {
        data = item;
        left = right = null;
    }
}

public class BinaryTree {
    class Height {
        int height = 0;
    }

    boolean isBalanced(Node node, Height height) {
        if (node == null)
            return true;

        Height lh = new Height(), rh = new Height();

        if (!isBalanced(node.left, lh))
            return false;

        if (!isBalanced(node.right, rh))
            return false;

        height.height = Math.max(lh.height, rh.height) +
1;

        if (Math.abs(lh.height - rh.height) <= 1)
            return true;

        return false;
    }
```

```
    public static void main(String args[]) {
        BinaryTree tree = new BinaryTree();
        Node root = new Node(1);
        root.left = new Node(2);
        root.right = new Node(3);
        root.left.left = new Node(4);
        root.left.right = new Node(5);
        root.left.left.left = new Node(8);

        BinaryTree.Height height = tree.new Height();
        if (tree.isBalanced(root, height))
            System.out.println("Tree is balanced");
        else
            System.out.println("Tree 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.

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

```
package com.dsassignment.day7;

import java.util.ArrayList;

public class MinHeap {
    private ArrayList<Integer> heap;

    public MinHeap() {
        heap = new ArrayList<>();
    }

    public void insert(int val) {
        heap.add(val);
        int index = heap.size() - 1;
        while (index > 0) {
            int parent = (index - 1) / 2;
            if (heap.get(parent) <= heap.get(index)) {
                break;
            }
            int temp = heap.get(parent);
            heap.set(parent, heap.get(index));
            heap.set(index, temp);
            index = parent;
        }
    }

    public int delete() {
        if (heap.size() == 0) {
            throw new IllegalStateException();
        }
        int removedVal = heap.get(0);
        int lastVal = heap.remove(heap.size() - 1);
        if (heap.size() > 0) {
            heap.set(0, lastVal);
            siftDown();
```

```
        }
        return removedVal;
    }

    public int getMin() {
        if (heap.size() == 0) {
            throw new IllegalStateException();
        }
        return heap.get(0);
    }

    public void printHeap() {
        System.out.println(heap);
    }

    private void siftDown() {
        int index = 0;
        int leftChild = 2 * index + 1;
        while (leftChild < heap.size()) {
            int minIndex = leftChild;
            int rightChild = leftChild + 1;
            if (rightChild < heap.size()) {
                if (heap.get(rightChild) <
heap.get(leftChild)) {
                    minIndex = rightChild;
                }
            }
            if (heap.get(index) <= heap.get(minIndex)) {
                break;
            }
            int temp = heap.get(index);
            heap.set(index, heap.get(minIndex));
            heap.set(minIndex, temp);
            index = minIndex;
            leftChild = 2 * index + 1;
        }
    }

    public static void main(String[] args) {
        MinHeap minHeap = new MinHeap();
        minHeap.insert(3);
        minHeap.insert(2);
        minHeap.insert(1);
```

```
        System.out.println("Heap: ");
        minHeap.printHeap();
        System.out.println("Minimum: " +
minHeap.getMin());
        System.out.println("Deleted: " +
minHeap.delete());
        System.out.println("Heap: ");
        minHeap.printHeap();
        System.out.println("Minimum: " +
minHeap.getMin());
    }
}
```

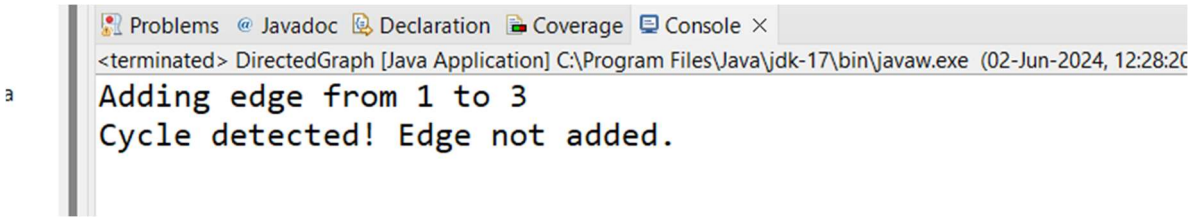
Task 4: Graph Edge Addition Validation
Given a directed graph, write a function that adds an edge between two nodes and then checks if the graph still has no cycles. If a cycle is created, the edge should not be added.

```
package com.dsassignment.day7;

import java.util.*;

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

    public DirectedGraph(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);
    }

    public 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;
    }

    private boolean isCyclicUtil(int v, boolean[]
visited, boolean[] recStack) {
        if (!visited[v]) {
            visited[v] = true;
            recStack[v] = true;

            Iterator<Integer> it = adj[v].iterator();
            while (it.hasNext()) {
                int n = it.next();
                if (!visited[n] && isCyclicUtil(n,
visited, recStack))
                    return true;
                else if (recStack[n])
                    return true;
            }
        }
        recStack[v] = false;
        return false;
    }

    public static void main(String args[]) {
        DirectedGraph g = new DirectedGraph(4);
        g.addEdge(0, 1);
        g.addEdge(1, 2);
        g.addEdge(2, 0);

        int u = 1;
```

```
        int v = 3;

        System.out.println("Adding edge from " + u + " to
" + v);
        g.addEdge(u, v);

        if (g.isCyclic())
            System.out.println("Cycle detected! Edge not
added.");
        else {
            System.out.println("Edge added
successfully.");
            System.out.println("Adjacency list after
adding edge:");
            for (int i = 0; i < g.V; ++i) {
                System.out.print(i + " -> ");
                for (Integer j : g.adj[i])
                    System.out.print(j + " ");
                System.out.println();
            }
        }
    }
}
```

Output:

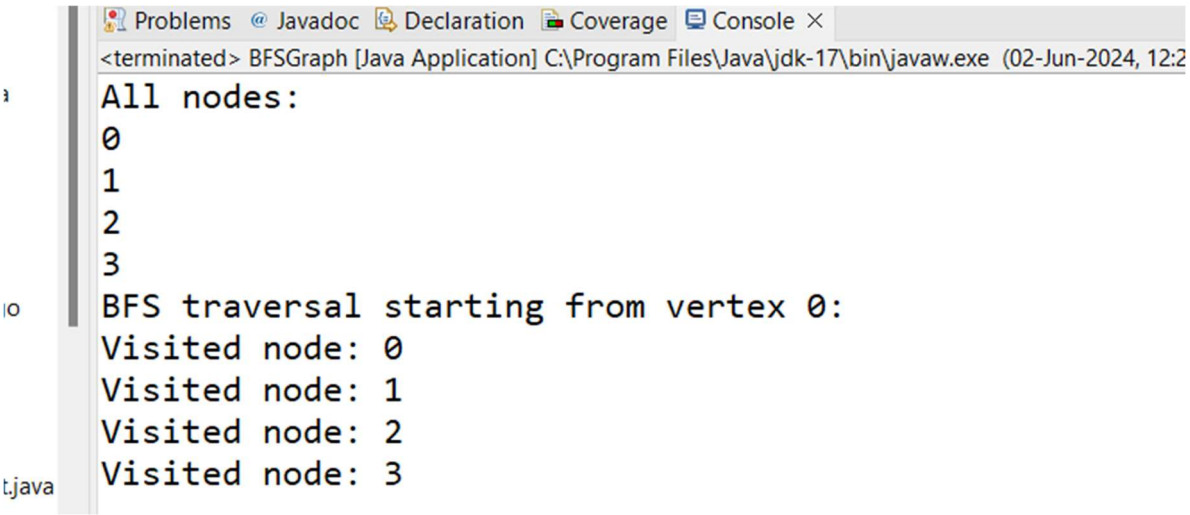


Task 5: Breadth-First Search (BFS) Implementation
For a given undirected graph, implement BFS to traverse the graph starting from a given node and print each node in the order it is visited.

```
package com.dsassignment.day7;
```

```java
import java.util.*;

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

    public BFSGraph(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 s) {
        boolean visited[] = new boolean[V];
        LinkedList<Integer> queue = new LinkedList<>();
        visited[s] = true;
        queue.add(s);
        System.out.println("BFS traversal starting from
vertex " + s + ":");
        while (queue.size() != 0) {
            s = queue.poll();
            System.out.println("Visited node: " + s);
            Iterator<Integer> i = adj[s].listIterator();
            while (i.hasNext()) {
                int n = i.next();
                if (!visited[n]) {
                    visited[n] = true;
                    queue.add(n);
                }
            }
        }
    }

    public static void main(String args[]) {
        BFSGraph g = new BFSGraph(4);
        g.addEdge(0, 1);
```

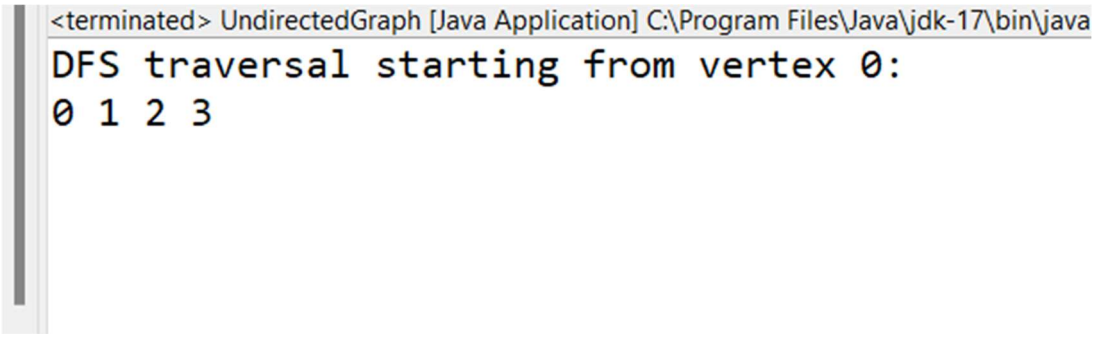
```
        g.addEdge(0, 2);
        g.addEdge(1, 2);
        g.addEdge(2, 3);
        System.out.println("All nodes:");
        for (int i = 0; i < 4; i++) {
            System.out.println(i);
        }
        g.BFS(0);
    }
}
```



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.

```
package com.dsassignment.day7;

import java.util.*;

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

    public UndirectedGraph(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 + " ");
        Iterator<Integer> i = adj[v].listIterator();
        while (i.hasNext()) {
            int n = i.next();
            if (!visited[n])
                DFSUtil(n, visited);
        }
    }

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

    public static void main(String args[]) {
        UndirectedGraph g = new UndirectedGraph(4);
        g.addEdge(0, 1);
        g.addEdge(0, 2);
        g.addEdge(1, 2);
        g.addEdge(2, 3);
        System.out.println("DFS traversal starting from
vertex 0:");
        g.DFS(0);
    }
}
```


<terminated> UndirectedGraph [Java Application] C:\Program Files\Java\jdk-17\bin\java
DFS traversal starting from vertex 0:
0 1 2 3