

Graph-1 Solutions

Solution 1:

Time Complexity : $O(V+E)$
Space Complexity: $O(V+E)$

```
import java.util.ArrayList;
import java.util.Arrays;
import java.util.LinkedList;
import java.util.Queue;

class Solution{

    public static void main(String args[]){

        int V = 4;
        @SuppressWarnings("unchecked")
        ArrayList <Integer> adj[] = new ArrayList[V];
        for(int i = 0; i < 4; i++)
            adj[i] = new ArrayList<Integer>();

        addEdge(adj, 0, 1);
        addEdge(adj, 1, 2);
        addEdge(adj, 2, 0);
        addEdge(adj, 2, 3);

        if (isCyclicDisconntected(adj, V))
            System.out.println("Yes");
        else
            System.out.println("No");
    }

    static void addEdge(ArrayList<Integer> adj[], int u, int v){
        adj[u].add(v);
        adj[v].add(u);
    }

    static boolean isCyclicConncted(
        ArrayList<Integer> adj[], int s,
        int V, boolean visited[]){
        int parent[] = new int[V];
```

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```
Arrays.fill(parent, -1);

Queue<Integer> q = new LinkedList<>();
visited[s] = true;
q.add(s);

while (!q.isEmpty()){
int u = q.poll();
for (int i = 0; i < adj[u].size(); i++){
    int v = adj[u].get(i);
    if (!visited[v]){
        visited[v] = true;
        q.add(v);
        parent[v] = u;
    }
    else if (parent[u] != v)
        return true;
}
}
return false;
}
```

```
static boolean isCyclicDisconnnected(
    ArrayList<Integer> adj[], int V){
    boolean visited[] = new boolean[V];
    Arrays.fill(visited, false);

    for (int i = 0; i < V; i++)
        if (!visited[i] &&
            isCyclicConncted(adj, i, V, visited))
            return true;
    return false;
}
```

Solution 2:

Time Complexity : $O(n)$
Space Complexity: $O(1)$

```
import java.util.*;
```

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```
class Solution{

    static class Node{
        int data;
        Node left, right;
    }

    static class qItem{
        Node node;
        int depth;

        public qItem(Node node, int depth){
            this.node = node;
            this.depth = depth;
        }
    }

    static int minDepth(Node root){
        if (root == null)
            return 0;
        Queue<qItem> q = new LinkedList<>();
        qItem qi = new qItem(root, 1);
        q.add(qi);

        while (q.isEmpty() == false){
            qi = q.peek();
            q.remove();
            Node node = qi.node;
            int depth = qi.depth;
            if (node.left == null && node.right == null)
                return depth;
            if (node.left != null){
                qi.node = node.left;
                qi.depth = depth + 1;
                q.add(qi);
            }

            if (node.right != null){
                qi.node = node.right;
                qi.depth = depth + 1;
            }
        }
    }
}
```

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```
        q.add(qi);
    }
}

return 0;
}

static Node newNode(int data){
    Node temp = new Node();
    temp.data = data;
    temp.left = temp.right = null;
    return temp;
}

public static void main(String[] args){
    Node root = newNode(1);
    root.left = newNode(2);
    root.right = newNode(3);
    root.left.left = newNode(4);
    root.left.right = newNode(5);

    System.out.println(minDepth(root));
}
}
```

Solution 3 :

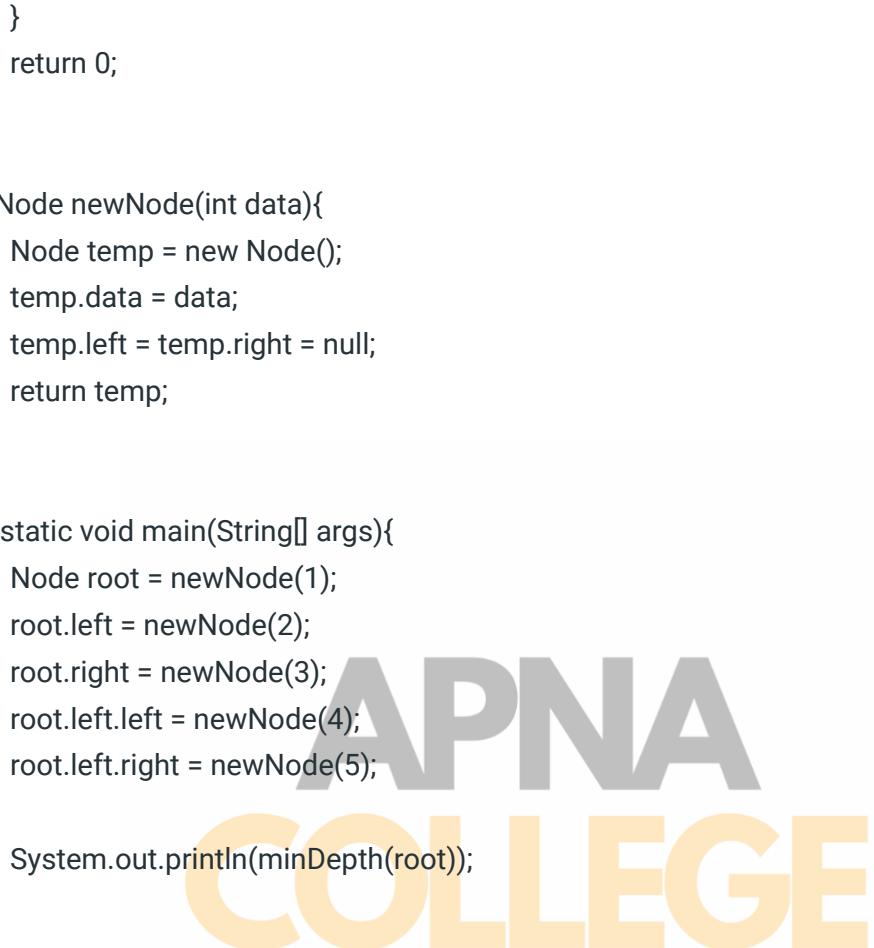
Time Complexity : $O(r*c)$

Space Complexity: $O(r*c)$

```
import java.util.LinkedList;
import java.util.Queue;

public class Solution{
    public final static int R = 3;
    public final static int C = 5;

    static class Ele{
        int x = 0;
```



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```
int y = 0;
Ele(int x,int y){
    this.x = x;
    this.y = y;
}
}

static boolean isValid(int i, int j){
    return (i >= 0 && j >= 0 && i < R && j < C);
}

static boolean isDelim(Ele temp){
    return (temp.x == -1 && temp.y == -1);
}

static boolean checkAll(int arr[][]){
    for (int i=0; i<R; i++)
        for (int j=0; j<C; j++)
            if (arr[i][j] == 1)
                return true;
    return false;
}

static int Solution(int arr[][]){
    Queue<Ele> Q=new LinkedList<>();
    Ele temp;
    int ans = 0;
    for (int i=0; i < R; i++)
        for (int j=0; j < C; j++)
            if (arr[i][j] == 2)
                Q.add(new Ele(i,j));
    Q.add(new Ele(-1,-1));

    while(!Q.isEmpty()){
        boolean flag = false;
        while(!isDelim(Q.peek())){
            temp = Q.peek();
            if(isValid(temp.x+1, temp.y) && arr[temp.x+1][temp.y] == 1){
                if(!flag){
                    if(flag)
                        ans++;
                    flag = true;
                }
                Q.add(new Ele(temp.x+1, temp.y));
                arr[temp.x+1][temp.y] = 0;
            }
            Q.remove();
        }
    }
    return ans;
}
```

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```
        ans++;
        flag = true;
    }
    arr[temp.x+1][temp.y] = 2;

    temp.x++;
    Q.add(new Ele(temp.x,temp.y));
    temp.x--;
}

if (isValid(temp.x-1, temp.y) && arr[temp.x-1][temp.y] == 1){
    if (!flag){
        ans++;
        flag = true;
    }
    arr[temp.x-1][temp.y] = 2;
    temp.x--;
    Q.add(new Ele(temp.x,temp.y)); // push this cell
    temp.x++;
}

if (isValid(temp.x, temp.y+1) && arr[temp.x][temp.y+1] == 1) {
    if(!flag){
        ans++;
        flag = true;
    }
    arr[temp.x][temp.y+1] = 2;
    temp.y++;
    Q.add(new Ele(temp.x,temp.y)); // Push this cell
    temp.y--;
}

if (isValid(temp.x, temp.y-1) && arr[temp.x][temp.y-1] == 1){
    if (!flag){
        ans++;
        flag = true;
    }
    arr[temp.x][temp.y-1] = 2;
    temp.y--;
}
```

to Queue

to Queue

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```
        Q.add(new Ele(temp.x,temp.y)); // push this cell
to Queue
    }

    Q.remove();

}

Q.remove();
if (!Q.isEmpty())
{
    Q.add(new Ele(-1,-1));
}
}

return (checkAll(arr))? -1: ans;
}

public static void main(String[] args){
    int arr[][] = { {2, 1, 0, 2, 1},
                    {1, 0, 1, 2, 1},
                    {1, 0, 0, 2, 1}};

    int ans = Solution(arr);
    if(ans == -1)
        System.out.println("All oranges cannot rot");
    else
        System.out.println("Time required for all oranges to rot = " + ans);
}
}
```

Solution 4 :

Time Complexity : $O(r*c)$
Space Complexity: $O(r*c)$

```
import java.io.*;
import java.util.*;

class Solution {
```

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```
static int ROW, COL, count;
static boolean isSafe(int[][] M, int row, int col,
                     boolean[][] visited)
{
    return (
        (row >= 0) && (row < ROW) && (col >= 0)
        && (col < COL)
        && (M[row][col] == 1 && !visited[row][col]));
}

static void DFS(int[][] M, int row, int col,
                boolean[][] visited){
    int[] rowNbr = { -1, -1, -1, 0, 0, 1, 1, 1 };
    int[] colNbr = { -1, 0, 1, -1, 1, -1, 0, 1 };

    visited[row][col] = true;
    for (int k = 0; k < 8; k++) {
        if (isSafe(M, row + rowNbr[k], col + colNbr[k],
                   visited)) {
            count++;
            DFS(M, row + rowNbr[k], col + colNbr[k],
                 visited);
        }
    }
}

static int largestRegion(int[][] M)      {

    boolean[][] visited = new boolean[ROW][COL];
    int result = 0;
    for (int i = 0; i < ROW; i++) {
        for (int j = 0; j < COL; j++) {
            if (M[i][j] == 1 && !visited[i][j]) {
                count = 1;
                DFS(M, i, j, visited);
                result = Math.max(result, count);
            }
        }
    }
    return result;
}
```

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```
}

public static void main(String args[]){
    int M[][] = { { 0, 0, 1, 1, 0 },
                  { 1, 0, 1, 1, 0 },
                  { 0, 1, 0, 0, 0 },
                  { 0, 0, 0, 1, 0 } };
    ROW = 4;
    COL = 5;
    System.out.println(largestRegion(M));
}
}
```

Solution 5 :

Time Complexity : $O(n^2 \cdot m)$

Space Complexity: $O(n \cdot m)$

```
import java.util.*;
```



```
class Solution {
    static int shortestChainLen(String start,
                               String target,
                               Set<String> D){

        if(start == target)
            return 0;
        if (!D.contains(target))
            return 0;
        int level = 0, wordlength = start.length();
        Queue<String> Q = new LinkedList<>();
        Q.add(start);
        while (!Q.isEmpty()){
            ++level;
            int sizeofQ = Q.size();
            for (int i = 0; i < sizeofQ; ++i){
                String s = Q.poll();
                for (int j = 0; j < wordlength; ++j){
                    char c = s.charAt(j);
                    String ns = s.substring(0, j) + (c - 1) + s.substring(j + 1);
                    if (ns.equals(target))
                        return level;
                    if (!D.contains(ns))
                        D.add(ns);
                    Q.add(ns);
                }
            }
        }
        return -1;
    }
}
```

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```
char []word = Q.peek().toCharArray();
Q.remove();
for (int pos = 0; pos < wordlength; ++pos){
    char orig_char = word[pos];
    for (char c = 'a'; c <= 'z'; ++c){
        word[pos] = c;
        if (String.valueOf(word).equals(target))
            return level + 1;
        if (!D.contains(String.valueOf(word)))
            continue;
        D.remove(String.valueOf(word));
        Q.add(String.valueOf(word));
    }
    word[pos] = orig_char;
}
return 0;
}

public static void main(String[] args){
    Set<String> D = new HashSet<String>();
    D.add("poon");
    D.add("plee");
    D.add("same");
    D.add("poie");
    D.add("plie");
    D.add("poin");
    D.add("plea");
    String start = "toon";
    String target = "plea";
    System.out.print("Length of shortest chain is: "
        + shortestChainLen(start, target, D));
}
```

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