Assignment - 9

Student Name: Nikhil Kumar Tiwari
UID:22BCS10471
Branch :BE-CSE
Section/Group:22BCS-IOT-FL-601 A
Semester: 6 th
Subject Code: 22CSP-351
Subject Name: Advanced Programming Lab- 2

1. Number of Islands:-

```
class Solution {
    public int numIslands(char[][] grid) {
        int row = grid.length;
        int col = grid[0].length;

        int islands = 0;

        for(int i = 0; i < row; i++){
            for(int j = 0; j < col; j++){
                if(grid[i][j] == '1'){
                    islands++;
                    dfs(i, j, grid);
                }
            }
        }
        return islands;
    }

    public void dfs(int row, int col, char[][] grid){
        int newRow = grid.length;
        int newCol = grid[0].length;
        int[][] directions = new int[][]{{0,1}, {1,0}, {0,-1}, {-1,0}};

        if(row<0 || row>=newRow || col<0 || col>=newCol || grid[row][col] ==
'0'){
            return;
        }
        grid[row][col] = '0';
        for(int[] dir: directions){
            dfs(row+dir[0], col+dir[1], grid);
        }
    }
```

}

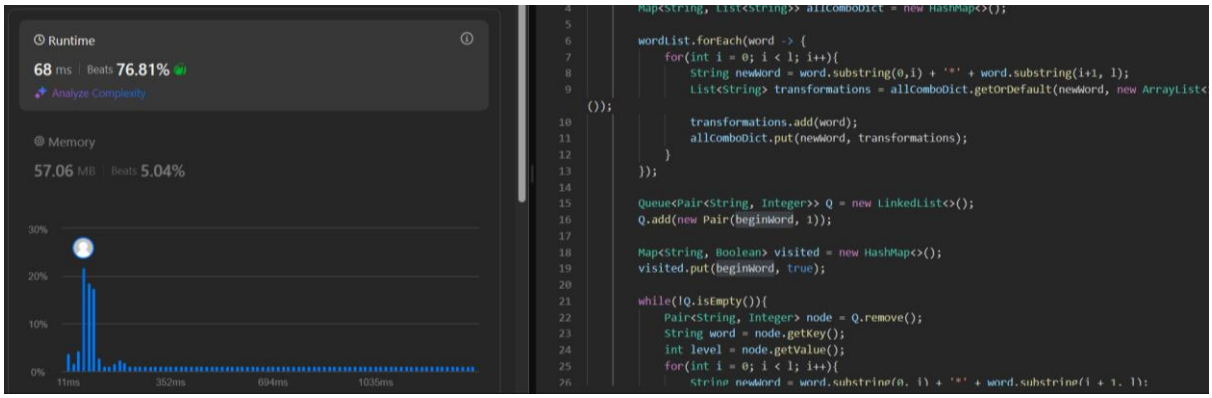
Result:-

2. Word Ladder:-

```
class Solution {
    public int ladderLength(String beginWord, String endWord, List<String>
wordList) {
        int l = beginWord.length();
        Map<String, List<String>> allComboDict = new HashMap<>();

        wordList.forEach(word -> {
            for(int i = 0; i < l; i++){
                String newWord = word.substring(0,i) + '*' + word.substring(i+1,
l);
                List<String> transformations =
allComboDict.getOrDefault(newWord, new ArrayList<>());
                transformations.add(word);
                allComboDict.put(newWord, transformations);
            }
        });

        Queue<Pair<String, Integer>> Q = new LinkedList<>();
        Q.add(new Pair(beginWord, 1));

        Map<String, Boolean> visited = new HashMap<>();
        visited.put(beginWord, true);
```

```
        while(!Q.isEmpty()){
            Pair<String, Integer> node = Q.remove();
            String word = node.getKey();
            int level = node.getValue();
            for(int i = 0; i < l; i++){
                String newWord = word.substring(0, i) + '*' + word.substring(i +
1, l);
                for(String adjacentWord : allComboDict.getOrDefault(newWord,
new ArrayList<>())){
                    if(adjacentWord.equals(endWord)){
                        return level + 1;
                    }
                    if(!visited.containsKey(adjacentWord)){
                        visited.put(adjacentWord, true);
                        Q.add(new Pair(adjacentWord, level + 1));
                    }
                }
            }
        }
        return 0;
    }
}
```

Result:-

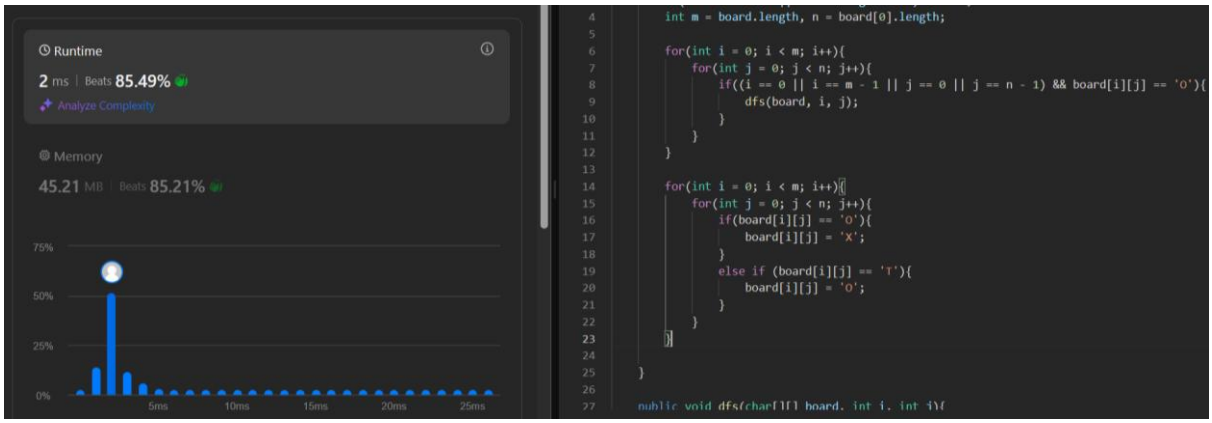


3. **Surrounded Regions:-**

```
class Solution {
    public void solve(char[][] board) {
```

```
        if(board == null || board.length == 0) return;
        int m = board.length, n = board[0].length;

        for(int i = 0; i < m; i++){
            for(int j = 0; j < n; j++){
                if((i == 0 || i == m - 1 || j == 0 || j == n - 1) && board[i][j] == 'O'){
                    dfs(board, i, j);
                }
            }
        }

        for(int i = 0; i < m; i++){
            for(int j = 0; j < n; j++){
                if(board[i][j] == 'O'){
                    board[i][j] = 'X';
                }
                else if (board[i][j] == 'T'){
                    board[i][j] = 'O';
                }
            }
        }

    }

    public void dfs(char[][] board, int i, int j){
        if(i < 0 || i >= board.length || j < 0 || j >= board[i].length || board[i][j] !=
'O'){
            return;
        }
        board[i][j] = 'T';
        dfs(board, i + 1, j);
        dfs(board, i - 1, j);
        dfs(board, i, j + 1);
        dfs(board, i, j - 1);
    }
}
```

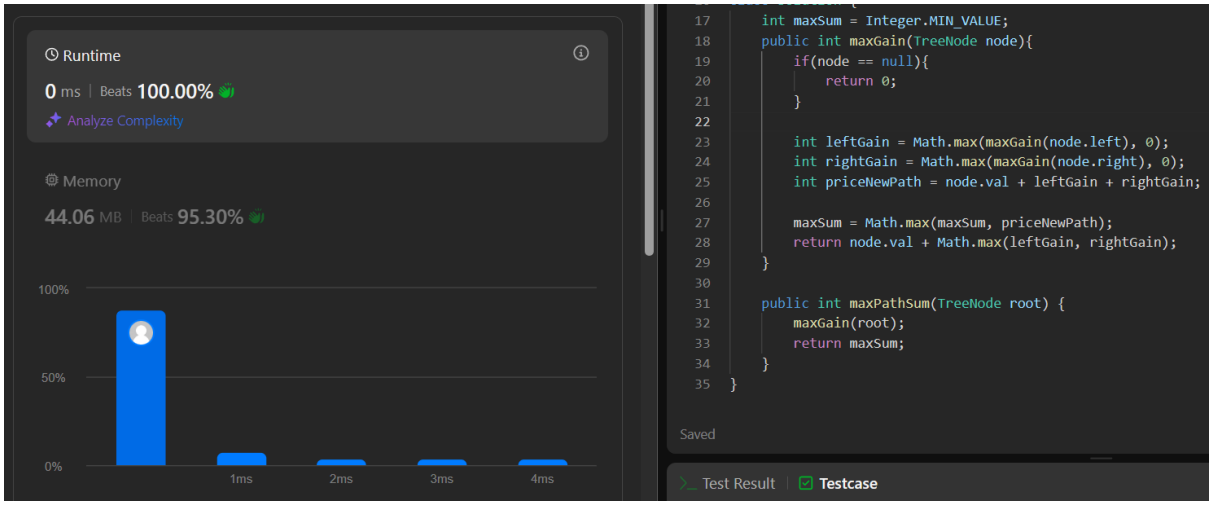
Result:-



4. **Binary Tree Maximum Path Sum:-**

```
class Solution {
    int maxSum = Integer.MIN_VALUE;
    public int maxGain(TreeNode node){
        if(node == null){
            return 0;
        }

        int leftGain = Math.max(maxGain(node.left), 0);
        int rightGain = Math.max(maxGain(node.right), 0);
        int priceNewPath = node.val + leftGain + rightGain;

        maxSum = Math.max(maxSum, priceNewPath);
        return node.val + Math.max(leftGain, rightGain);
    }

    public int maxPathSum(TreeNode root) {
        maxGain(root);
        return maxSum;
    }
}
```

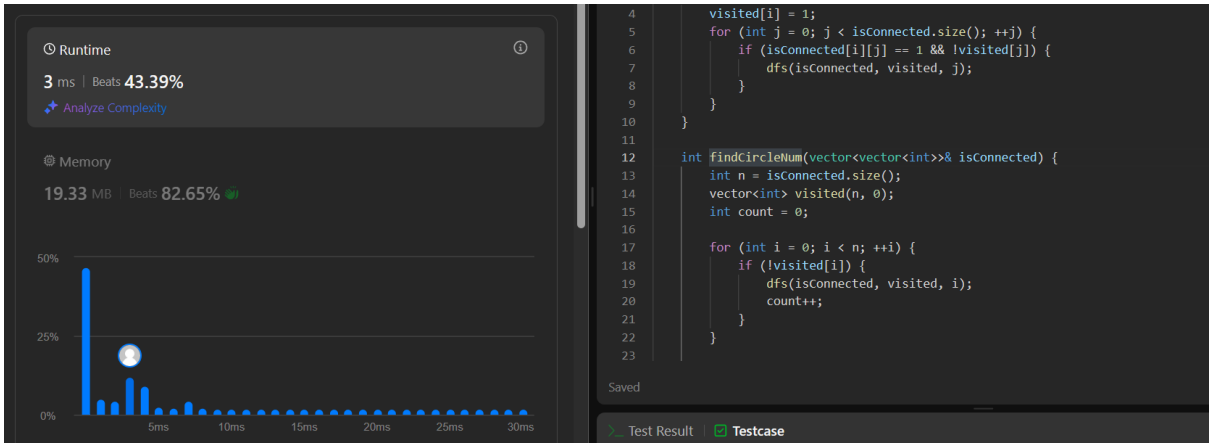
Result:-



5. Friend Circles:-

```
class Solution {
public:
    void dfs(vector<vector<int>>& isConnected, vector<int>& visited, int i){
        visited[i] = 1;
        for (int j = 0; j < isConnected.size(); ++j) {
            if (isConnected[i][j] == 1 && !visited[j]) {
                dfs(isConnected, visited, j);
            }
        }
    }
    int findCircleNum(vector<vector<int>>& isConnected) {
        int n = isConnected.size();
        vector<int> visited(n, 0);
        int count = 0;
        for (int i = 0; i < n; ++i) {
            if (!visited[i]) {
                dfs(isConnected, visited, i);
                count++;
            }
        }
        return count;
    }
};
```

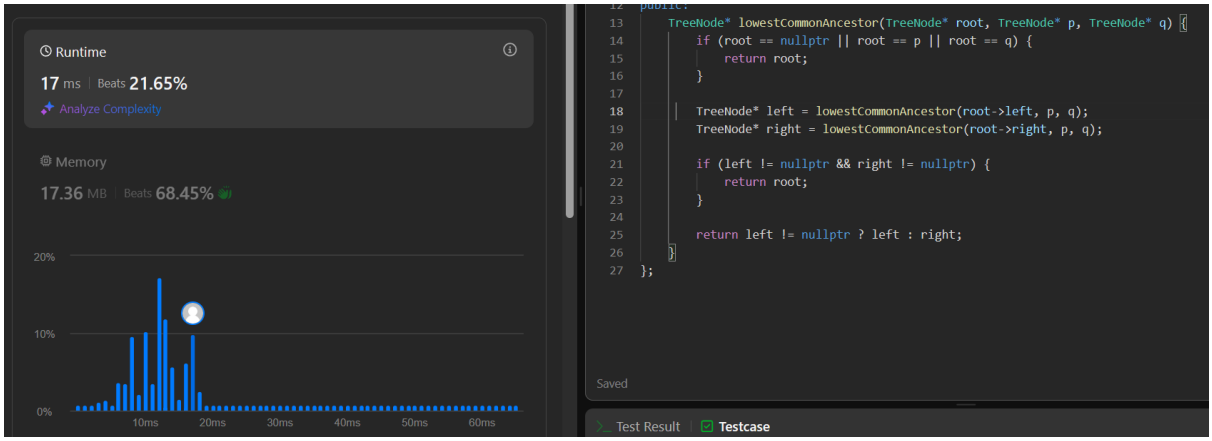
Result:-



6. Lowest Common Ancestor of a Binary Tree:-

```
/* Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };  */

class Solution {
public:
    TreeNode* lowestCommonAncestor(TreeNode* root, TreeNode* p,
TreeNode* q) {
        if (root == nullptr || root == p || root == q) {
            return root;
        }

        TreeNode* left = lowestCommonAncestor(root->left, p, q);
        TreeNode* right = lowestCommonAncestor(root->right, p, q);
        if (left != nullptr && right != nullptr) {
            return root;
        }
        return left != nullptr ? left : right;
    }
};
```

Result:-

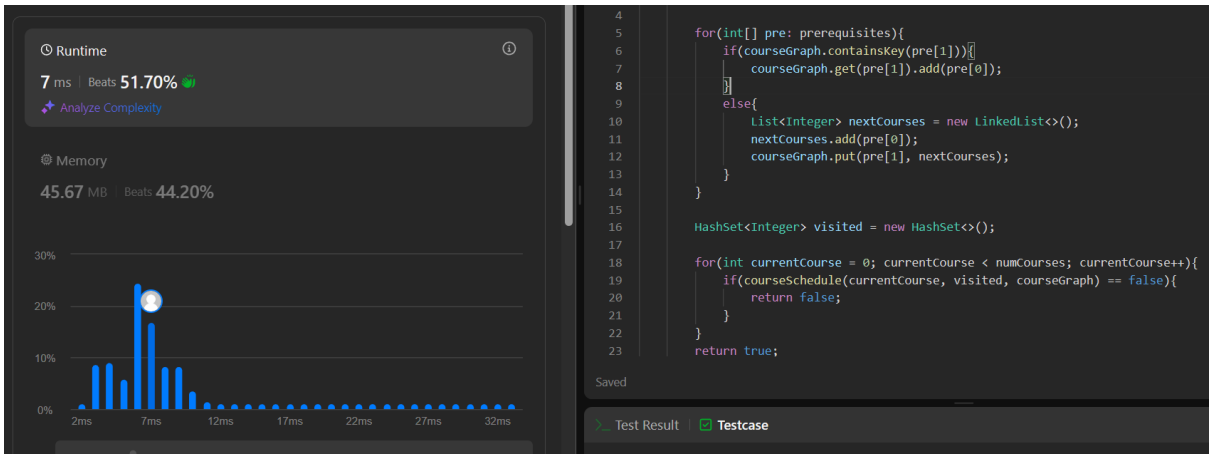


7. Course Schedule:-

```
class Solution {
    public boolean canFinish(int numCourses, int[][] prerequisites) {
        HashMap<Integer, List<Integer>> courseGraph = new HashMap<>();

        for(int[] pre: prerequisites){
            if(courseGraph.containsKey(pre[1])){
                courseGraph.get(pre[1]).add(pre[0]);
            }
            else{
                List<Integer> nextCourses = new LinkedList<>();
                nextCourses.add(pre[0]);
                courseGraph.put(pre[1], nextCourses);
            }
        }

        HashSet<Integer> visited = new HashSet<>();

        for(int currentCourse = 0; currentCourse < numCourses;
currentCourse++){
            if(courseSchedule(currentCourse, visited, courseGraph) == false){
                return false;
            }
        }
        return true;
    }
```

```
    public boolean courseSchedule(int course, HashSet<Integer> visited,
HashMap<Integer, List<Integer>> courseGraph){
        if(visited.contains(course)){
            return false;
        }
        if(courseGraph.get(course) == null){
            return true;
        }
        visited.add(course);
        for(int pre: courseGraph.get(course)){
            if(courseSchedule(pre, visited, courseGraph) == false){
                return false;
            }
        }
        visited.remove(course);
        courseGraph.put(course, null);
        return true;
    }
}
```

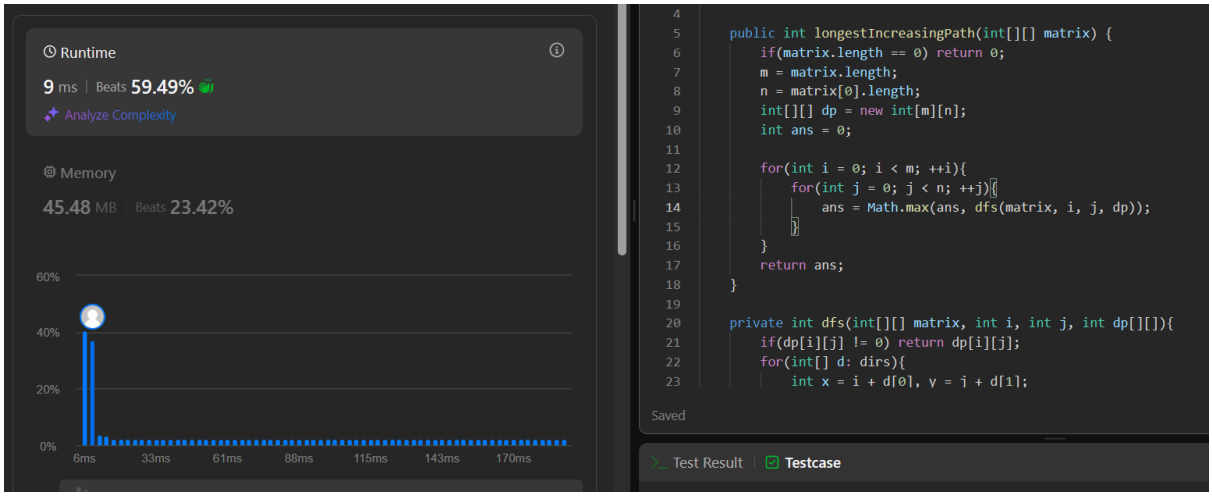
Result:-



8. Longest Increasing Path in a Matrix:-

```
class Solution {
    private static int[][] dirs = {{0,1}, {0,-1}, {-1,0}, {1,0}};
    private int m, n;

    public int longestIncreasingPath(int[][] matrix) {
        if(matrix.length == 0) return 0;
        m = matrix.length;
        n = matrix[0].length;
        int[][] dp = new int[m][n];
        int ans = 0;

        for(int i = 0; i < m; ++i){
            for(int j = 0; j < n; ++j){
                ans = Math.max(ans, dfs(matrix, i, j, dp));
            }
        }
        return ans;
    }

    private int dfs(int[][] matrix, int i, int j, int dp[][]){
        if(dp[i][j] != 0) return dp[i][j];
        for(int[] d: dirs){
            int x = i + d[0], y = j + d[1];
            if(x >= 0 && x < m && y >= 0 && y < n && matrix[x][y] >
matrix[i][j]){
                dp[i][j] = Math.max(dp[i][j], dfs(matrix, x, y, dp));
            }
        }
        return ++dp[i][j];
    }
}
```

Result:-



9. Course Schedule II:-

```
class Solution {
  static int WHITE = 1;
  static int GRAY = 2;
  static int BLACK = 3;

  boolean isPossible;
  Map<Integer, Integer> color;
  Map<Integer, List<Integer>> adjList;
  List<Integer> topologicalOrder;

  private void init(int numCourses) {
    this.isPossible = true;
    this.color = new HashMap<Integer, Integer>();
    this.adjList = new HashMap<Integer, List<Integer>>();
    this.topologicalOrder = new ArrayList<Integer>();

    for (int i = 0; i < numCourses; i++) {
      this.color.put(i, WHITE);
    }
  }

  private void dfs(int node) {
    if (!this.isPossible) {
      return;
    }
```

```
    this.color.put(node, GRAY);

    for (Integer neighbor : this.adjList.getOrDefault(node, new
ArrayList<Integer>())) {
      if (this.color.get(neighbor) == WHITE) {
        this.dfs(neighbor);
      } else if (this.color.get(neighbor) == GRAY) {
        this.isPossible = false;
      }
    }

    this.color.put(node, BLACK);
    this.topologicalOrder.add(node);
  }

  public int[] findOrder(int numCourses, int[][] prerequisites) {

    this.init(numCourses);

    for (int i = 0; i < prerequisites.length; i++) {
      int dest = prerequisites[i][0];
      int src = prerequisites[i][1];
      List<Integer> lst = adjList.getOrDefault(src, new ArrayList<Integer>());
      lst.add(dest);
      adjList.put(src, lst);
    }

    for (int i = 0; i < numCourses; i++) {
      if (this.color.get(i) == WHITE) {
        this.dfs(i);
      }
    }

    int[] order;
    if (this.isPossible) {
      order = new int[numCourses];
      for (int i = 0; i < numCourses; i++) {
```

```
        order[i] = this.topologicalOrder.get(numCourses - i - 1);
      }
    } else {
      order = new int[0];
    }

    return order;
  }
}
```

Result:-