

DAY 7

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Section: 620A

Question 1: -

WAP to find the degree of given vertex in a graph

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
class Graph {
```

```
public:
```

```
    int V;
```

```
    vector<vector<int>> adjList;
```

```
    Graph(int vertices) {
```

```
        V = vertices;
```

```
        adjList.resize(V);
```

```
    }
```

```
    void addEdge(int u, int v) {
```

```
        adjList[u].push_back(v);
```

```
        adjList[v].push_back(u);
```

```
    }
```

```
int getDegree(int vertex) {  
    return adjList[vertex].size();  
}  
};
```

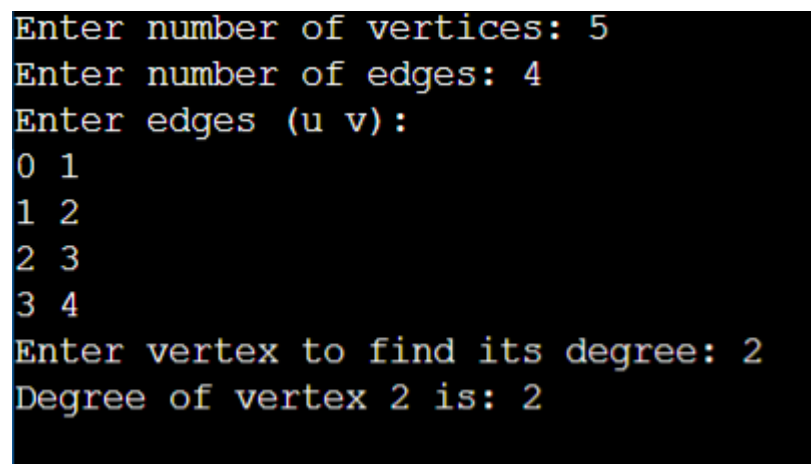
```
int main() {  
    int vertices, edges;  
    cout << "Enter number of vertices: ";  
    cin >> vertices;  
    Graph g(vertices);  
  
    cout << "Enter number of edges: ";  
    cin >> edges;  
  
    cout << "Enter edges (u v): \n";  
    for (int i = 0; i < edges; i++) {  
        int u, v;  
        cin >> u >> v;  
        g.addEdge(u, v);  
    }
```

```
int vertex;  
cout << "Enter vertex to find its degree: ";  
cin >> vertex;
```

```
    cout << "Degree of vertex " << vertex << " is: " <<
g.getDegree(vertex) << endl;
```

```
    return 0;
}
```

OUTPUT: -



```
Enter number of vertices: 5
Enter number of edges: 4
Enter edges (u v):
0 1
1 2
2 3
3 4
Enter vertex to find its degree: 2
Degree of vertex 2 is: 2
```

Question 2: -

WAP for DFS

```
#include <iostream>
```

```
#include <vector>
```

```
#include <stack>
```

```
using namespace std;
```

```
class Graph {
```

```
public:
```

```
    int V;
```

```
    vector<vector<int>> adjList;
```

```
Graph(int vertices) {  
    V = vertices;  
    adjList.resize(V);  
}  
  
void addEdge(int u, int v) {  
    adjList[u].push_back(v);  
    adjList[v].push_back(u);  
}  
  
void DFS(int start) {  
    vector<bool> visited(V, false);  
    stack<int> s;  
    s.push(start);  
    visited[start] = true;  
  
    while (!s.empty()) {  
        int node = s.top();  
        s.pop();  
        cout << node << " ";  
        for (int adj : adjList[node]) {  
            if (!visited[adj]) {  
                visited[adj] = true;  
                s.push(adj);  
            }  
        }  
    }  
}
```

```
    }  
    }  
    cout << endl;  
}  
};
```

```
int main() {  
    int vertices, edges;  
    cout << "Enter number of vertices: ";  
    cin >> vertices;  
    Graph g(vertices);  
  
    cout << "Enter number of edges: ";  
    cin >> edges;  
  
    cout << "Enter edges (u v): \n";  
    for (int i = 0; i < edges; i++) {  
        int u, v;  
        cin >> u >> v;  
        g.addEdge(u, v);  
    }  
  
    int start;  
    cout << "Enter starting vertex for DFS: ";
```

```

    cin >> start;

    cout << "DFS traversal starting from vertex " << start << ": ";
    g.DFS(start);

    return 0;
}

```

OUTPUT: -

```

Enter number of vertices: 5
Enter number of edges: 4
Enter edges (u v):
0 1
1 2
2 3
3 4
Enter starting vertex for DFS: 0
DFS traversal starting from vertex 0: 0 1 2 3 4

```

Question 3: -

WAP to detect a cycle in undirected graph

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
class Graph {
```

```
public:
```

```
    int V;
```

```
    vector<vector<int>> adjList;
```

```

Graph(int vertices) {
    V = vertices;
    adjList.resize(V);
}

void addEdge(int u, int v) {
    adjList[u].push_back(v);
    adjList[v].push_back(u);
}

bool DFS(int node, vector<bool>& visited, vector<int>& parent) {
    visited[node] = true;
    for (int adj : adjList[node]) {
        if (!visited[adj]) {
            parent[adj] = node;
            if (DFS(adj, visited, parent))
                return true;
        }
        else if (parent[node] != adj) {
            return true;
        }
    }
    return false;
}

bool detectCycle() {
    vector<bool> visited(V, false);

```

```

vector<int> parent(V, -1);
for (int i = 0; i < V; i++) {
    if (!visited[i]) {
        if (DFS(i, visited, parent))
            return true;
    }
}
return false;
}
};

```

```

int main() {
    int vertices, edges;
    cout << "Enter number of vertices: ";
    cin >> vertices;
    Graph g(vertices);

    cout << "Enter number of edges: ";
    cin >> edges;

    cout << "Enter edges (u v): \n";
    for (int i = 0; i < edges; i++) {
        int u, v;
        cin >> u >> v;
    }
}

```



```

        g.addEdge(u, v);
    }

    if (g.detectCycle()) {
        cout << "Graph contains a cycle." << endl;
    } else {
        cout << "Graph does not contain any cycle." << endl;
    }

    return 0;
}

```

OUTPUT: -

```

Enter number of vertices: 5
Enter number of edges: 4
Enter edges (u v):
0 1
1 2
2 3
3 4
Graph does not contain any cycle.

```

Question 4: -

Given the root of complete binary tree return the number of nodes in the tree

```

#include <iostream>

using namespace std;

struct TreeNode {

```

```

int val;
TreeNode *left;
TreeNode *right;
TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}
};

```

```

class Solution {
public:
    int getHeight(TreeNode* root) {
        int height = 0;
        while (root) {
            height++;
            root = root->left;
        }
        return height;
    }
    int countNodes(TreeNode* root) {
        if (!root) return 0;

        int height = getHeight(root);
        if (height == 0) return 0;

        int left = 1, right = (1 << height) - 1;
        while (left < right) {

```

```

    int mid = (left + right + 1) / 2;
    if (exists(root, height, mid)) {
        left = mid;
    } else {
        right = mid - 1;
    }
}

return left + (1 << (height - 1)) - 1;
}

```

private:

```

bool exists(TreeNode* root, int height, int index) {
    int left = 0, right = (1 << height) - 1;
    for (int i = 0; i < height - 1; i++) {
        int mid = (left + right) / 2;
        if (index <= mid) {
            root = root->left;
            right = mid;
        } else {
            root = root->right;
            left = mid + 1;
        }
    }
}

```

```

        return root != nullptr;
    }
};

int main() {
    TreeNode* root = new TreeNode(1);
    root->left = new TreeNode(2);
    root->right = new TreeNode(3);
    root->left->left = new TreeNode(4);
    root->left->right = new TreeNode(5);
    root->right->left = new TreeNode(6);

    Solution solution;

    cout << "Number of nodes in the tree: " <<
    solution.countNodes(root) << endl;

    return 0;
}

```

OUTPUT: -

```
Number of nodes in the tree: 8
```

Question 5: -

A binary tree find the max depth of binary tree

```
#include <iostream>
```

```
using namespace std;
```

```
struct TreeNode {  
    int val;  
    TreeNode *left;  
    TreeNode *right;  
    TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}  
};
```

```
class Solution {  
public:  
    int maxDepth(TreeNode* root) {  
        if (root == nullptr) {  
            return 0;  
        }  
        int leftDepth = maxDepth(root->left);  
        int rightDepth = maxDepth(root->right);  
        return 1 + max(leftDepth, rightDepth);  
    }  
};
```

```
int main() {  
    TreeNode* root = new TreeNode(1);  
    root->left = new TreeNode(2);  
    root->right = new TreeNode(3);  
    root->left->left = new TreeNode(4);
```

```
root->left->right = new TreeNode(5);
```

```
Solution solution;
```

```
cout << "Maximum depth of the binary tree: " <<  
solution.maxDepth(root) << endl;
```

```
return 0;
```

```
}
```

OUTPUT: -

```
Maximum depth of the binary tree: 3
```

Question 6: -

Given the root of binary tree return preorder traverse of its node value

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
struct TreeNode {
```

```
    int val;
```

```
    TreeNode* left;
```

```
    TreeNode* right;
```

```
    TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}
```

```
};
```

```
class Solution {
```

public:

```
vector<int> preorderTraversal(TreeNode* root) {  
    vector<int> result;  
    preorderHelper(root, result);  
    return result;  
}
```

private:

```
void preorderHelper(TreeNode* node, vector<int>& result) {  
    if (node == nullptr) {  
        return;  
    }  
    result.push_back(node->val);  
    preorderHelper(node->left, result);  
    preorderHelper(node->right, result);  
}  
};
```

int main() {

```
    TreeNode* root = new TreeNode(1);  
    root->left = new TreeNode(2);  
    root->right = new TreeNode(3);  
    root->left->left = new TreeNode(4);  
    root->left->right = new TreeNode(5);
```

```

Solution solution;
vector<int> result = solution.preorderTraversal(root);
cout << "Preorder traversal: ";
for (int val : result) {
    cout << val << " ";
}
cout << endl;

return 0;
}

```

OUTPUT: -

```
Preorder traversal: 1 2 4 5 3
```

Question 7: -

given a binary tree the task is to count the leaf node A node is a leaf node is both the left and right value are null

```
#include <iostream>
```

```
using namespace std;
```

```
struct TreeNode {
```

```
    int val;
```

```
    TreeNode* left;
```

```
    TreeNode* right;
```

```
    TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}
```



```
};
```

```
class Solution {
```

```
public:
```

```
    int countLeafNodes(TreeNode* root) {
```

```
        if (root == nullptr) {
```

```
            return 0;
```

```
        }
```

```
        if (root->left == nullptr && root->right == nullptr) {
```

```
            return 1;
```

```
        }
```

```
        return countLeafNodes(root->left) + countLeafNodes(root->right);
```

```
    }
```

```
};
```

```
int main() {
```

```
    TreeNode* root = new TreeNode(1);
```

```
    root->left = new TreeNode(2);
```

```
    root->right = new TreeNode(3);
```

```
    root->left->left = new TreeNode(4);
```

```
    root->left->right = new TreeNode(5);
```

```
    Solution solution;
```

```

int leafCount = solution.countLeafNodes(root);
cout << "Number of leaf nodes: " << leafCount << endl;

return 0;
}

```

OUTPUT: -

```

Number of leaf nodes: 3

```

Question 8: -

implementation off cyclic graph

```

#include <iostream>

```

```

#include <vector>

```

```

#include <unordered_map>

```

```

using namespace std;

```

```

class Graph {

```

```

private:

```

```

    unordered_map<int, vector<int>> adjList;

```

```

public:

```

```

    void addEdge(int src, int dest) {

```

```

        adjList[src].push_back(dest);

```

```

    }

```

```

    bool detectCycleUtil(int node, unordered_map<int, int>& visited) {

```

```

    if (visited[node] == 1) {
        return true;
    }
    visited[node] = 1;
    for (int neighbor : adjList[node]) {
        if (visited[neighbor] != 2 && detectCycleUtil(neighbor, visited))
        {
            return true;
        }
    }
    visited[node] = 2;
    return false;
}

bool detectCycle() {
    unordered_map<int, int> visited;
    for (const auto& pair : adjList) {
        if (visited[pair.first] == 0) {
            if (detectCycleUtil(pair.first, visited)) {
                return true;
            }
        }
    }
    return false;
}

```

```
};
```

```
int main() {
```

```
    Graph g;
```

```
    g.addEdge(0, 1);
```

```
    g.addEdge(1, 2);
```

```
    g.addEdge(2, 0);
```

```
    if (g.detectCycle()) {
```

```
        cout << "Cycle detected in the graph!" << endl;
```

```
    } else {
```

```
        cout << "No cycle detected in the graph." << endl;
```

```
    }
```

```
    return 0;
```

```
}
```

OUTPUT: -

```
Cycle detected in the graph!
```

Question 9: -

find the centre of the star graph

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
int findCenter(vector<vector<int>>& adjList) {
```

```
    int n = adjList.size();
```

```
    for (int i = 0; i < n; i++) {
```

```
        if (adjList[i].size() == n - 1) {
```

```
            return i;
```

```
        }
```

```
    }
```

```
    return -1
```

```
}
```

```
int main() {
```

```
    int n = 5;
```

```
    vector<vector<int>> adjList(n);
```

```
    adjList[0] = {1, 2, 3, 4};
```

```
    adjList[1] = {0};
```

```
    adjList[2] = {0};
```

```
    adjList[3] = {0};
```

```
    adjList[4] = {0};
```

```
    int center = findCenter(adjList);
```

```
    cout << "The center of the star graph is node: " << center << endl;
```

```
    return 0;
}
```

OUTPUT: -

```
The center of the star graph is node: 0
```

Question 10: -

Write a program to detect a cycle in a directed graph by using DFS

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
class Graph {
```

```
public:
```

```
    int V;
```

```
    vector<vector<int>> adj;
```

```
    Graph(int V);
```

```
    void addEdge(int u, int v);
```

```
    bool dfs(int node, vector<bool>& visited, vector<bool>&
recursionStack);
```

```
    bool hasCycle();
```

```
};
```

```
Graph::Graph(int V) {
```

```
    this->V = V;
```

```

    adj.resize(V);
}

void Graph::addEdge(int u, int v) {
    adj[u].push_back(v);
}

bool Graph::dfs(int node, vector<bool>& visited, vector<bool>&
recursionStack) {
    visited[node] = true;
    recursionStack[node] = true;
    for (int neighbor : adj[node]) {
        if (recursionStack[neighbor]) {
            return true;
        }
        if (!visited[neighbor] && dfs(neighbor, visited, recursionStack)) {
            return true;
        }
    }
    recursionStack[node] = false;
    return false;
}

bool Graph::hasCycle() {
    vector<bool> visited(V, false);
    vector<bool> recursionStack(V, false);
    for (int i = 0; i < V; i++) {

```

```
        if (!visited[i]) {  
            if (dfs(i, visited, recursionStack)) {  
                return true;  
            }  
        }  
    }  
    return false;  
}
```

```
int main() {  
    int V = 4;  
    Graph g(V);  
    g.addEdge(0, 1);  
    g.addEdge(1, 2);  
    g.addEdge(2, 3);  
    g.addEdge(3, 1);  
    if (g.hasCycle()) {  
        cout << "The graph contains a cycle." << endl;  
    } else {  
        cout << "The graph does not contain a cycle." << endl;  
    }  
  
    return 0;  
}
```


OUTPUT: -

```
The graph contains a cycle.
```