ASSIGNMENT NO 1

Title of the Assignment:

Design and implement Parallel Breadth First Search and Depth First Search based on existing algorithms using OpenMP. Use a Tree or an undirected graph for BFS and DFS

Objective:

1. Implement parallel BFS and DFS algorithms using OpenMP.
2. Utilize either tree or an undirected graph data structure.

Outcome:

Students should understand basic of OPENMP programming module using BFSand DFS

Prerequisites:

Understanding of graph theory knowledge of openMP, data structure, knowledge.

Software Requirement:

OpenMP, Programming language, c/c++ compiler

Hardware Requirement:

x86_64 bit, 2 – 2/4 GB DDR RAM, 80 - 500 GB SATA HD.

Source

```
#include<iostream>
#include<omp.h>
#include<bits/stdc++.h>
using namespace std;
class Graph{
public:
// vector<vector<int>> graph;
// vector<bool> visited;
// int vertices = 0;
// int edges = 0;
int vertices = 6;
int edges = 5;
vector<vector<int>>graph={{1},{0,2,3},{1,4,5},{1,4},{2,3},{2}};
vector<bool> visited;
// Graph(){
// cout << "Enter number of nodes: ";
// cin >> vertices;
// cout << "Enter number of edges: ";
// cin >> edges;
// graph.assign(vertices,vector<int>());
// for(int i = 0 ; i < edges;i++){
// int a,b;
// cout << "Enter adjacent nodes: ";
// cin >> a >> b;
// addEdge(a,b);
// }
// }
void addEdge(int a, int b){
graph[a].push_back(b);
```

```
graph[b].push_back(a);
}
void printGraph(){
for(int i = 0; i < vertices; i++){
cout << i << " -> ";
for(auto j = graph[i].begin(); j != graph[i].end();j++){
cout << *j << " ";
}
cout << endl;
}
}
void initialize_visited(){
visited.assign(vertices,false);
}
void dfs(int i){
stack<int> s;
s.push(i);
visited[i] = true;
while(s.empty() != true){
int current = s.top();
cout << current << " ";
s.pop();
for(auto j = graph[current].begin(); j != graph[current].end();j++){
if(visited[*j] == false){
s.push(*j);
visited[*j] = true;
}
}
}
}
```

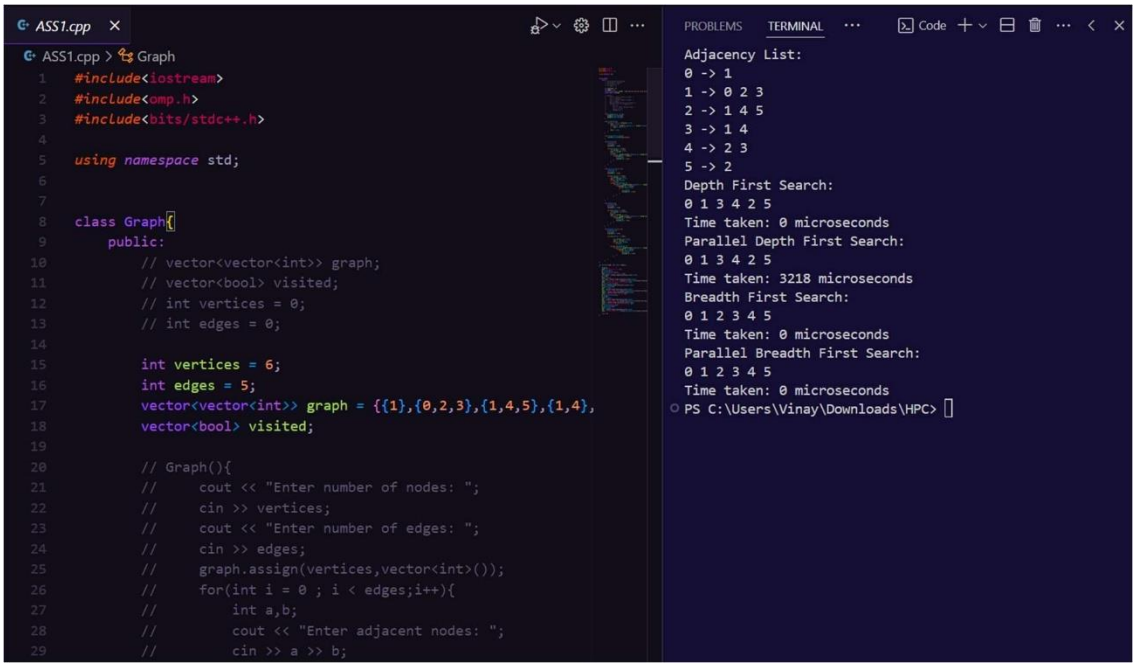
```
void parallel_dfs(int i){
stack<int> s;
s.push(i);
visited[i] = true;
while(s.empty() != true){
int current = s.top();
cout << current << " ";
#pragma omp critical
s.pop();
#pragma omp parallel for
for(autoj=graph[current].begin();j!=graph[current].end();j++){
if(visited[*j] == false){
#pragma omp critical
{
s.push(*j);
visited[*j] = true;
}
}
}
}
}
void bfs(int i){
queue<int> q;
q.push(i);
visited[i] = true;
while(q.empty() != true){
int current = q.front();
q.pop();
cout << current << " ";
for(auto j = graph[current].begin(); j != graph[current].end();j++){
```

```
if(visited[*j] == false){
q.push(*j);
visited[*j] = true;
}
}
}
}
void parallel_bfs(int i){
queue<int> q;
q.push(i);
visited[i] = true;
while(q.empty() != true){
int current = q.front();
cout << current << " ";
#pragma omp critical
q.pop();
#pragma omp parallel for
for(auto j = graph[current].begin(); j != graph[current].end();j++){
if(visited[*j] == false){
#pragma omp critical
q.push(*j);
visited[*j] = true;
}
}
}
}
};
int main(int argc, char const *argv[])
{
Graph g;
```

```
cout << "Adjacency List:\n";
g.printGraph();
g.initialize_visited();
cout << "Depth First Search: \n";
auto start = chrono::high_resolution_clock::now();
g.dfs(0);
cout << endl;
auto end = chrono::high_resolution_clock::now();
cout << "Time taken: " << chrono::duration_cast<chrono::microseconds>(end
- start).count() << " microseconds" << endl;
cout << "Parallel Depth First Search: \n";
g.initialize_visited();
start = chrono::high_resolution_clock::now();
g.parallel_dfs(0);
cout << endl;
end = chrono::high_resolution_clock::now();
cout << "Time taken: "<< chrono::duration_cast<chrono::microseconds>(end
- start).count() << " microseconds" << endl;
start = chrono::high_resolution_clock::now();
cout << "Breadth First Search: \n";
g.initialize_visited();
g.bfs(0);
cout << endl;
end = chrono::high_resolution_clock::now();
cout << "Time taken: "<< chrono::duration_cast<chrono::microseconds>(end
- start).count() << " microseconds" << endl;
start = chrono::high_resolution_clock::now();
cout << "Parallel Breadth First Search: \n";
g.initialize_visited();
g.parallel_bfs(0);
```

```
cout << endl;
end = chrono::high_resolution_clock::now();
cout << "Time taken: " << chrono::duration_cast<chrono::microseconds>(end
- start).count() << " microseconds" << endl;
return 0;
}
```

OUTPUT:



Conclusion:

Implemented parallel BFS and DFS using OpenMP.