

LAPORAN PRAKTIKUM 6

ANALISIS ALGORITMA

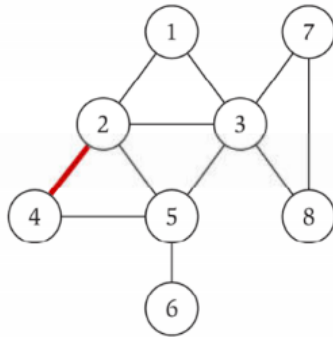


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Tugas Anda

1. Dengan menggunakan *undirected graph* dan *adjacency matrix* berikut, buatlah koding programnya menggunakan bahasa C++.



	1	2	3	4	5	6	7	8
1	0	1	1	0	0	0	0	0
2	1	0	1	1	1	0	0	0
3	1	1	0	0	1	0	1	1
4	0	1	0	1	1	0	0	0
5	0	1	1	1	0	1	0	0
6	0	0	0	0	1	0	0	0
7	0	0	1	0	0	0	0	1
8	0	0	1	0	0	0	1	0

Source code

```
#include <iostream>
#include <cstdlib>
using namespace std;
#define MAX 20

class AdjacencyMatrix
{
private:
    int n;
    int **adj;
    bool *visited;
public:
    AdjacencyMatrix(int n)
    {
        this->n = n;
        visited = new bool [n];
        adj = new int* [n];
        for (int i = 0; i < n; i++)
        {
            adj[i] = new int [n];
            for(int j = 0; j < n; j++)
            {
                adj[i][j] = 0;
            }
        }
    }

    void add_edge(int origin, int destin)
    {
        if( origin > n || destin > n || origin < 0 || destin < 0)
        {
            cout<<"Invalid edge!\n";
        }
        else
        {
            adj[origin - 1][destin - 1] = 1;
        }
    }

    void display()
```

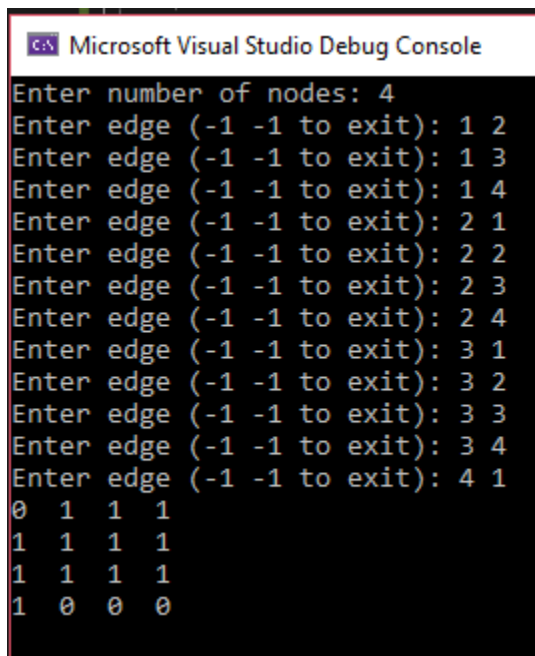
```

        {
            int i,j;
            for(i = 0;i < n;i++)
            {
                for(j = 0; j < n; j++)
                    cout<<adj[i][j]<<" ";
                cout<<endl;
            }
        };

int main()
{
    int nodes, max_edges, origin, destin;
    cout<<"Enter number of nodes: ";
    cin>>nodes;
    AdjacencyMatrix am(nodes);
    max_edges = nodes * (nodes - 1);
    for (int i = 0; i < max_edges; i++)
    {
        cout<<"Enter edge (-1 -1 to exit): ";
        cin>>origin>>destin;
        if((origin == -1) && (destin == -1))
            break;
        am.add_edge(origin, destin);
    }
    am.display();
    return 0;
}

```

Screenshot:



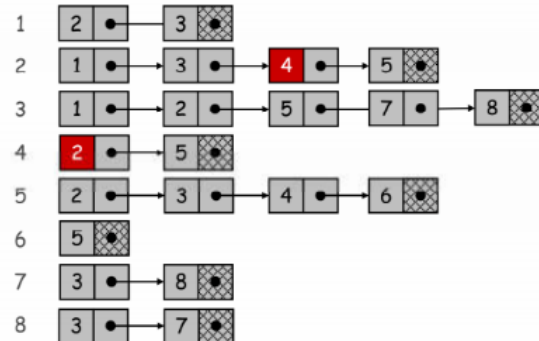
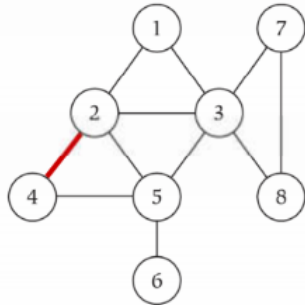
```

Microsoft Visual Studio Debug Console

Enter number of nodes: 4
Enter edge (-1 -1 to exit): 1 2
Enter edge (-1 -1 to exit): 1 3
Enter edge (-1 -1 to exit): 1 4
Enter edge (-1 -1 to exit): 2 1
Enter edge (-1 -1 to exit): 2 2
Enter edge (-1 -1 to exit): 2 3
Enter edge (-1 -1 to exit): 2 4
Enter edge (-1 -1 to exit): 3 1
Enter edge (-1 -1 to exit): 3 2
Enter edge (-1 -1 to exit): 3 3
Enter edge (-1 -1 to exit): 3 4
Enter edge (-1 -1 to exit): 4 1
0 1 1 1
1 1 1 1
1 1 1 1
1 0 0 0

```

2. Dengan menggunakan *undirected graph* dan representasi *adjacency list*, buatlah koding programnya menggunakan bahasa C++.



Source code:

```
#include <iostream>
#include <cstdlib>
using namespace std;

struct AdjListNode
{
    int dest;
    struct AdjListNode* next;
};

struct AdjList
{
    struct AdjListNode *head;
};

class Graph
{
private:
    int V;
    struct AdjList* array;
public:
    Graph(int V)
    {
        this->V = V;
        array = new AdjList [V];
        for (int i = 0; i < V; ++i)
            array[i].head = NULL;
    }

    AdjListNode* newAdjListNode(int dest)
    {
        AdjListNode* newNode = new AdjListNode;
        newNode->dest = dest;
        newNode->next = NULL;
        return newNode;
    }

    void addEdge(int src, int dest)
    {
        AdjListNode* newNode = newAdjListNode(dest);
```

```

        newNode->next = array[src].head;
        array[src].head = newNode;
        newNode = newAdjListNode(src);
        newNode->next = array[dest].head;
        array[dest].head = newNode;
    }

    void printGraph()
    {
        int v;
        for (v = 1; v < V; ++v)
        {
            AdjListNode* pCrawl = array[v].head;
            cout<<"\n Adjacency list of vertex "<<v<<"\n head ";
            while (pCrawl)
            {
                cout<<"-> "<<pCrawl->dest;
                pCrawl = pCrawl->next;
            }
            cout<<endl;
        }
    };

int main()
{
    Graph gh(8);
    gh.addEdge(1, 2);
    gh.addEdge(1, 3);
    gh.addEdge(2, 4);
    gh.addEdge(2, 5);
    gh.addEdge(2, 3);
    gh.addEdge(3, 7);
    gh.addEdge(3, 8);
    gh.addEdge(4, 5);
    gh.addEdge(5, 3);
    gh.addEdge(5, 6);
    gh.addEdge(7, 8);

    // print the adjacency list representation of the above graph
    gh.printGraph();

    return 0;
}

```

Screenshot:

```
Microsoft Visual Studio Debug Console

Adjacency list of vertex 1
head -> 3-> 2

Adjacency list of vertex 2
head -> 3-> 5-> 4-> 1

Adjacency list of vertex 3
head -> 5-> 8-> 7-> 2-> 1

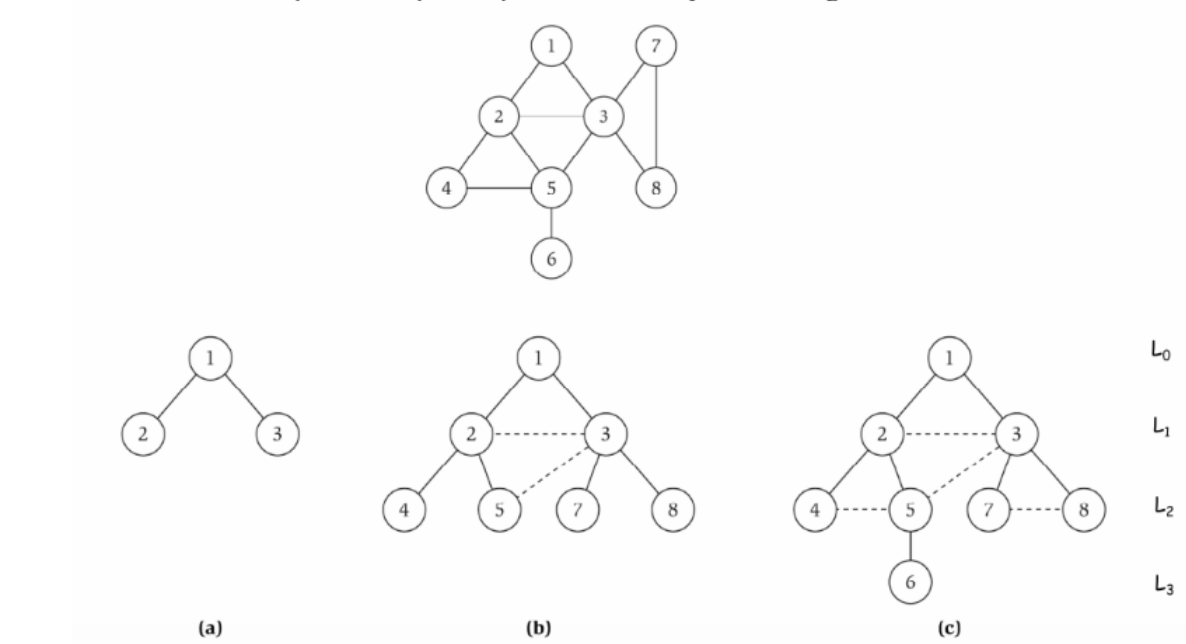
Adjacency list of vertex 4
head -> 5-> 2

Adjacency list of vertex 5
head -> 6-> 3-> 4-> 2

Adjacency list of vertex 6
head -> 5

Adjacency list of vertex 7
head -> 8-> 3
```

3. Buatlah program Breadth First Search dari algoritma BFS yang telah diberikan. Kemudian uji coba program Anda dengan menginputkan *undirected graph* sehingga menghasilkan tree BFS. Hitung dan berikan secara asimptotik berapa kompleksitas waktunya dalam Big- Θ !



Source code:

```
#include<iostream>
using namespace std;
```

```

int main(){
    int vertexSize = 8;
    int adjacency[8][8] = {
        {0,1,1,0,0,0,0,0},
        {1,0,1,1,1,0,0,0},
        {1,1,0,0,1,0,1,1},
        {0,1,0,0,1,0,0,0},
        {0,1,1,1,0,1,0,0},
        {0,0,0,0,1,0,0,0},
        {0,0,1,0,0,0,0,1},
        {0,0,1,0,0,0,1,0}
    };

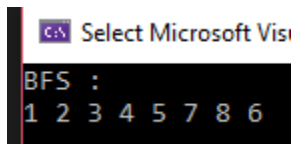
    bool discovered[vertexSize];
    for(int i = 0; i < vertexSize; i++){
        discovered[i] = false;
    }
    int output[vertexSize];

    discovered[0] = true;
    output[0] = 1;

    int counter = 1;
    for(int i = 0; i < vertexSize; i++){
        for(int j = 0; j < vertexSize; j++){
            if((adjacency[i][j] == 1)&&(discovered[j] == false)){
                output[counter] = j+1;
                discovered[j] = true;
                counter++;
            }
        }
    }
    cout<<"BFS : "<<endl;
    for(int i = 0; i < vertexSize; i++){
        cout<<output[i]<<" ";
    }
}

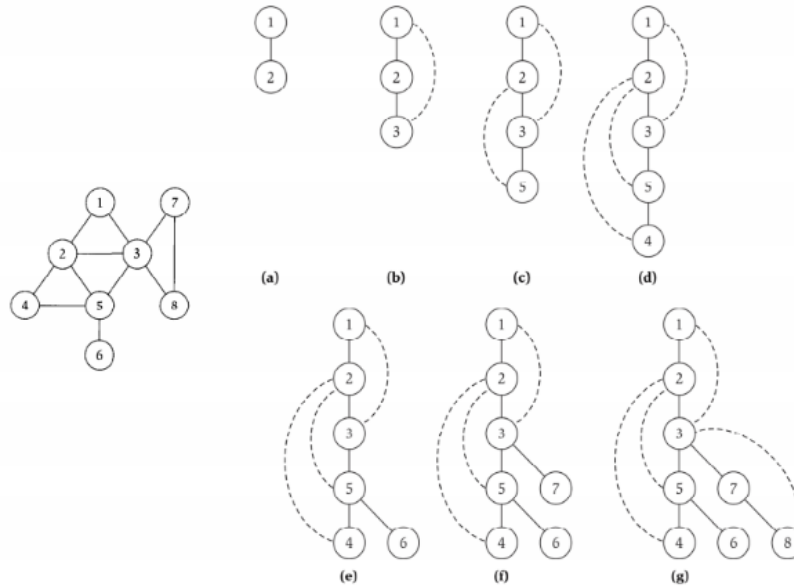
```

Screenshot:



BFS adalah metode pencarian secara melebar, jadi mencari di 1 level dulu dari kiri ke kanan. Kalau sudah dikunjungi semua nodenya maka pencarian dilanjut ke level berikutnya. Worst case BFS harus mempertimbangkan semua jalur (path) untuk semua node yang mungkin, maka nilai kompleksitas waktu dari BFS adalah $O(|V| + |E|)$. Karena Big-O dari BFS adalah $O(V+E)$ dimana V itu jumlah vertex dan E itu adalah jumlah edges maka Big-O = $O(n)$ dimana $n = v + e$. Maka dari itu Big- Θ nya adalah $\Theta(n)$.

4. Buatlah program Depth First Search dari algoritma DFS yang telah diberikan. Kemudian uji coba program Anda dengan menginputkan *undirected graph* sehingga menghasilkan *tree DFS*. Hitung dan berikan secara asimptotik berapa kompleksitas waktunya dalam Big- Θ !



```
#include <iostream>
#include <list>

using namespace std;

class Graph{
    int N;

    list<int> *adj;

    void DFSUtil(int u, bool visited[]){
        visited[u] = true;
        cout << u << " ";

        list<int>::iterator i;
        for(i = adj[u].begin(); i != adj[u].end(); i++){
            if(!visited[*i]){
                DFSUtil(*i, visited);
            }
        }
    }

public :
    Graph(int N){
        this->N = N;
        adj = new list<int>[N];
    }

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

    void DFS(int u){
        bool *visited = new bool[N];
        for(int i = 0; i < N; i++){
```



```

        visited[i] = false;
    }
    DFSUtil(u, visited);
}
};

int main(){
    Graph g(8);

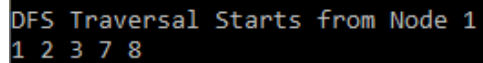
    g.addEdge(1,2);
    g.addEdge(1,3);
    g.addEdge(2,3);
    g.addEdge(2,4);
    g.addEdge(2,5);
    g.addEdge(3,7);
    g.addEdge(3,8);
    g.addEdge(4,5);
    g.addEdge(5,3);
    g.addEdge(5,6);
    g.addEdge(7,8);

    cout << "\nDFS Traversal Starts from Node 1" << endl;
    g.DFS(1);

    return 0;
}

```

Screenshot:



```

DFS Traversal Starts from Node 1
1 2 3 7 8

```

DFS merupakan metode pencarian mendalam, yang mengunjungi semua node dari yang ter kiri lalu geser ke kanan hingga semua node dikunjungi. Kompleksitas ruang algoritma DFS adalah $O(bm)$, karena kita hanya perlu menyimpan satu buah lintasan tunggal dari akar sampai daun, ditambah dengan simpul simpul saudara kandungnya yang belum dikembangkan.