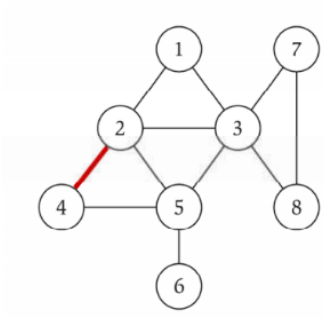
Analisis Algoritma

Disusun oleh :
Meira Dwiana Anjani
140810180015

FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS PADJADJARAN
2020

Tugas Anda

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

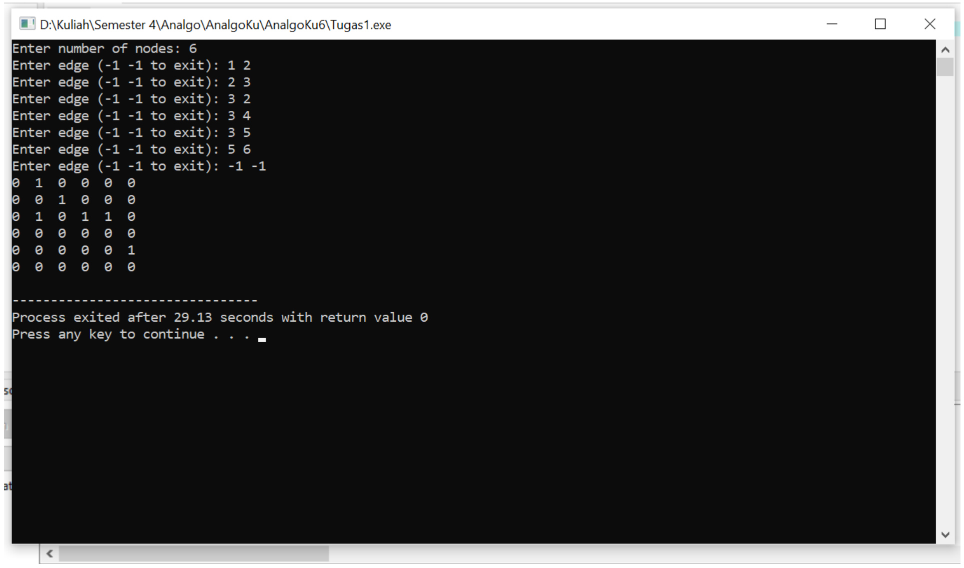


	1	2	3	4	5	6	7	8
1	0	1	1	0	0	0	0	0
2	1	0	1	1	1	0	0	0
3	1	1	0	0	1	0	1	1
4	0	1	0	1	1	0	0	0
5	0	1	1	1	0	1	0	0
6	0	0	0	0	1	0	0	0
7	0	0	1	0	0	0	0	1
8	0	0	1	0	0	0	1	0

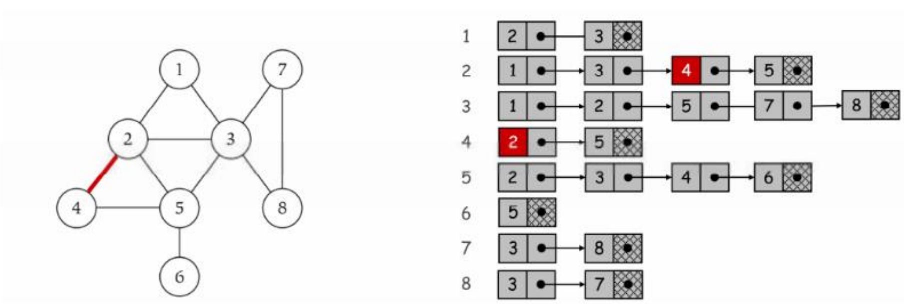
```
/*
Nama : Meira Dwiana A
NPM  : 140810180015
Kelas: A
*/


#include <iostream>
#include <cstdlib>
using namespace std;
#define MAX 20
/*
 * Class untuk Adjacency Matrix
 */
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;
                }
            }
        }
        /*
         * Menambahkan edge ke graf
```

```
         */
        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;
            }
        }
        /*
         * Mencetak graf
         */
        void display()
        {
            int i,j;
            for(i = 0;i < n;i++)
            {
                for(j = 0; j < n; j++)
                    cout<<adj[i][j]<<"  ";
                cout<<endl;
            }
        }
};
/*
 * Main
 */
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;
}
```

Meira Dwiana 140810180015 Tugas 6



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




```
/*
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NPM  : 140810180015
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*/

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

/*
 * Adjacency List Node
 */
struct AdjListNode
{
    int dest;
    struct AdjListNode* next;
};

/*
```
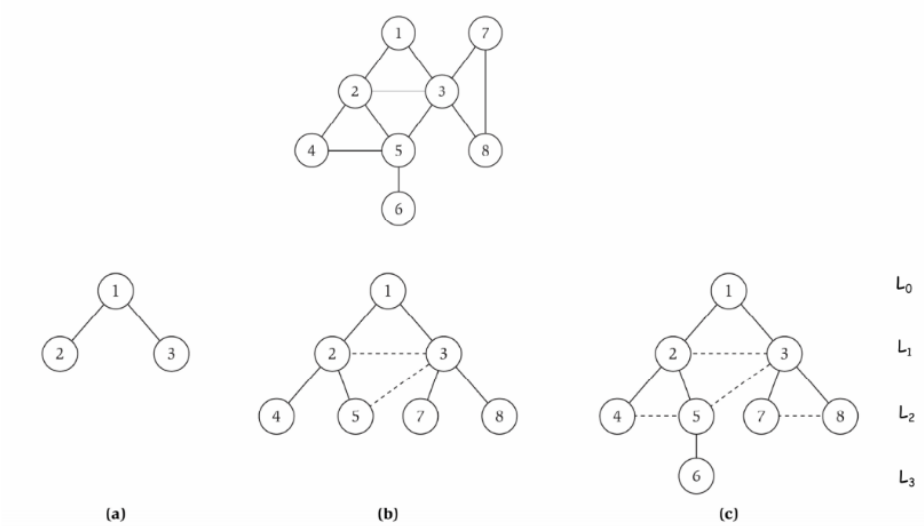

```
 * Adjacency List
 */
struct AdjList
{
    struct AdjListNode *head;
};

/*
 * Class Graph
 */
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;
        }
        /*
         * Creating New Adjacency List Node
         */
        AdjListNode* newAdjListNode(int dest)
        {
            AdjListNode* newNode = new AdjListNode;
            newNode->dest = dest;
            newNode->next = NULL;
            return newNode;
        }
        /*
         * Adding Edge to Graph
         */
        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;
        }
        /*
         * Print the graph
         */
        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;
            }
        }
};

/*
 * Main
 */
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;
}
```

```
D:\Kuliah\Semester 4\Analgo\AnalgoKu\AnalgoKu6\Tugas2.exe

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

Adjacency list of vertex 8
head -> 7-> 3
--------------------------------
Process exited after 3.219 seconds with return value 3221225477
Press any key to continue . . .
```

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!




```
/*
Nama : Meira Dwiana Anjani
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*/

// Program to print BFS traversal from a given
// source vertex. BFS(int s) traverses vertices
// reachable from s.
#include<iostream>
#include <list>

using namespace std;
```
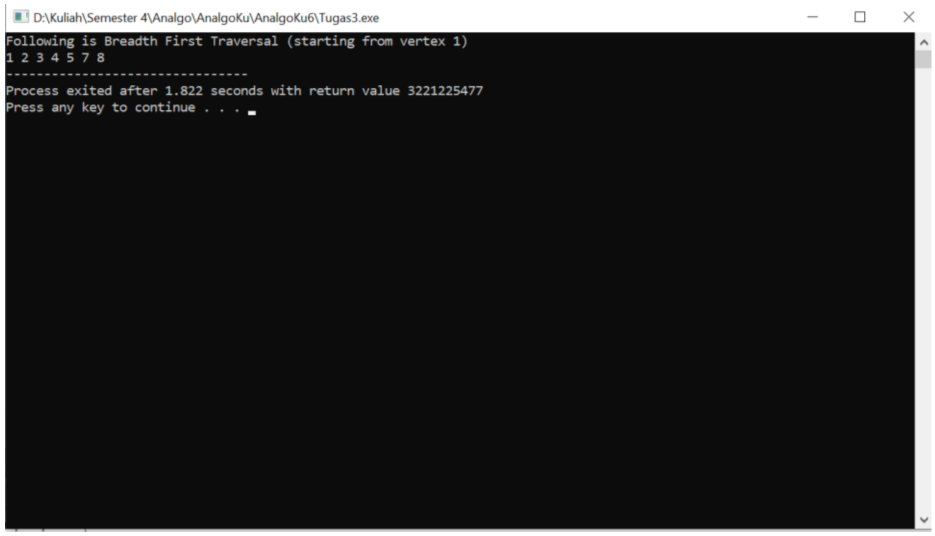
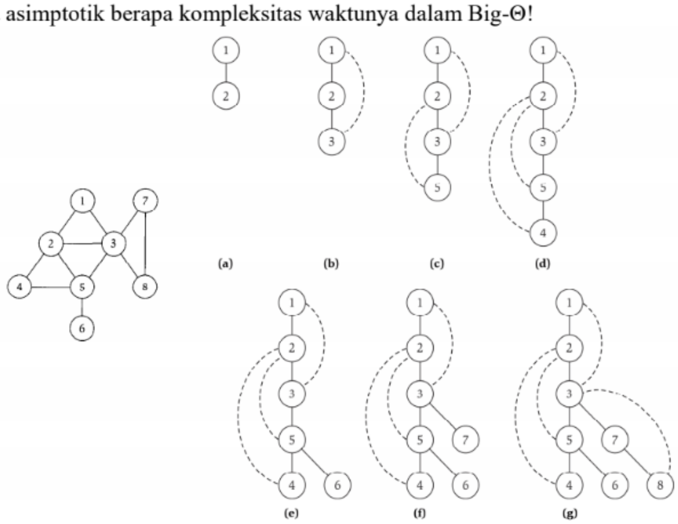

```
// This class represents a directed graph using
// adjacency list representation
class Graph
{
      int V; // No. of vertices

      // Pointer to an array containing adjacency
      // lists
      list<int> *adj;
public:
      Graph(int V); // Constructor

      // function to add an edge to graph
      void addEdge(int v, int w);

      // prints BFS traversal from a given source s
      void BFS(int s);
};

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

void Graph::addEdge(int v, int w)
{
      adj[v].push_back(w); // Add w to v’s list.
}

void Graph::BFS(int s)
{
      // Mark all the vertices as not visited
      bool *visited = new bool[V];
      for(int i = 0; i < V; i++)
            visited[i] = false;

      // Create a queue for BFS
      list<int> queue;

      // Mark the current node as visited and enqueue it
      visited[s] = true;
      queue.push_back(s);

      // 'i' will be used to get all adjacent
      // vertices of a vertex
      list<int>::iterator i;

      while(!queue.empty())
      {
```

```
            // Dequeue a vertex from queue and print it
            s = queue.front();
            cout << s << " ";
            queue.pop_front();

            // Get all adjacent vertices of the dequeued
            // vertex s. If a adjacent has not been visited,
            // then mark it visited and enqueue it
            for (i = adj[s].begin(); i != adj[s].end(); ++i)
            {
                  if (!visited[*i])
                  {
                        visited[*i] = true;
                        queue.push_back(*i);
                  }
            }
      }
}

// Driver program to test methods of graph class
int main()
{
      // Create a graph given in the above diagram
      Graph g(8);
    g.addEdge(1, 2);
    g.addEdge(1, 3);
      g.addEdge(2, 4);
      g.addEdge(2, 5);
      g.addEdge(2, 3);
      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 << "Following is Breadth First Traversal "
            << "(starting from vertex 1) \n";
      g.BFS(1);

      return 0;
}
```



Kompleksitas ruang algoritma DFS adalah O(bm), karena kita hanya hanya perlu menyimpan satu buah lintasan tunggal dari akar sampai daun, ditambah dengan simpul-simpul saudara kandungnya yang belum dikembangkan.

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!




```
/*
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*/

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

```
// Graph class merepresentasikan graf berarah menggunakan representasi
adjacency list
class Graph
{
	int V; // No. simpul

	// Pointer ke array yang memiliki adjacency lists
	list<int> *adj;

	// Fungsi rekursif yang digunakan DFS
	void DFSUtil(int v, bool visited[]);
public:
	Graph(int V); // Constructor

	// fungsi untuk menambah tepian ke graf
	void addEdge(int v, int w);

	// DFS traversal dari simpul yang terjangkau dari v
	void DFS(int v);
};

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

void Graph::addEdge(int v, int w)
{
	adj[v].push_back(w); // Menambah w ke list v.
}

void Graph::DFSUtil(int v, bool visited[])
{
	// Menandakan node bersangkutan sudah dikunjungi lalu cetak
	visited[v] = true;
	cout << v << " ";

	// Ulang simpul berdekatan ke node ini
	list<int>::iterator i;
	for (i = adj[v].begin(); i != adj[v].end(); ++i)
		if (!visited[*i])
			DFSUtil(*i, visited);
}

// DFS traversal dari simpul terjangkau dari v.
// Menggunakan rekursif DFSUtil()
void Graph::DFS(int v)
{
	// Menandakan semua simpul belum dikunjungi
```

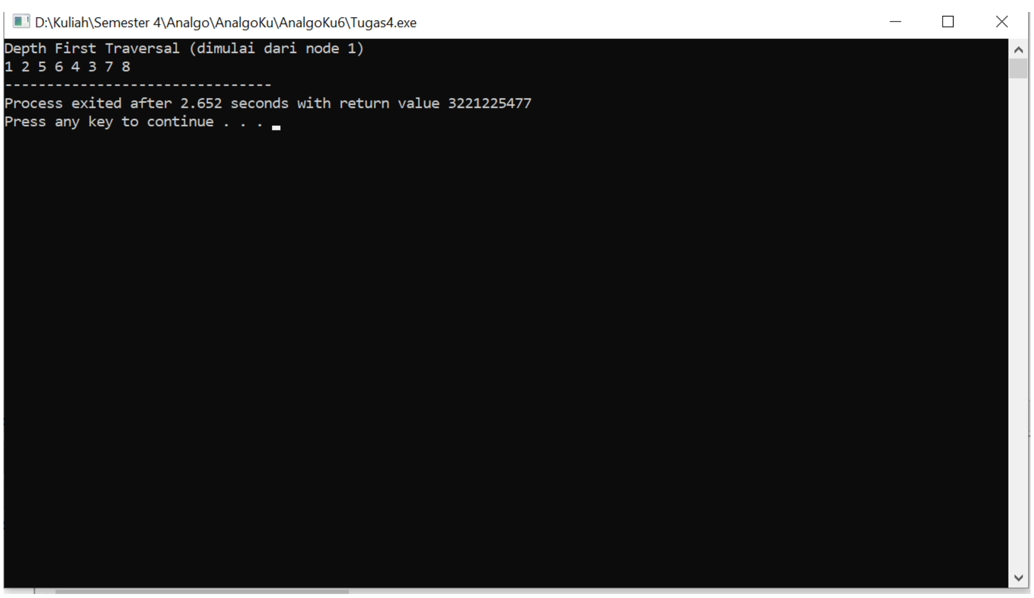
```
        bool *visited = new bool[V];
        for (int i = 0; i < V; i++)
                visited[i] = false;

        // Memanggil fungsi rekursif pembantu untuk mencetak DFS
traversal
        DFSUtil(v, visited);
}

int main()
{
        // Membuat graf di diagram
        Graph g(8);
        g.addEdge(1, 2);
        g.addEdge(1, 3);
        g.addEdge(2, 5);
        g.addEdge(2, 4);
        g.addEdge(5, 6);
        g.addEdge(3, 7);
        g.addEdge(3, 8);
        g.addEdge(7, 8);

        cout << "Depth First Traversal"
                " (dimulai dari node 1) \n";
        g.DFS(1);

        return 0;
}
```



Kompleksitas ruang algoritma DFS adalah O(bm), karena kita hanya hanya perlu menyimpan satu buah lintasan tunggal dari akar sampai daun, ditambah dengan simpul-simpul saudara kandungnya yang belum dikembangkan.