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Algorithm Lab. Class Assignment-12

CSE Group 1

Date: - 22nd October 2021

1. Write a C program to implement Depth First Search.

Program

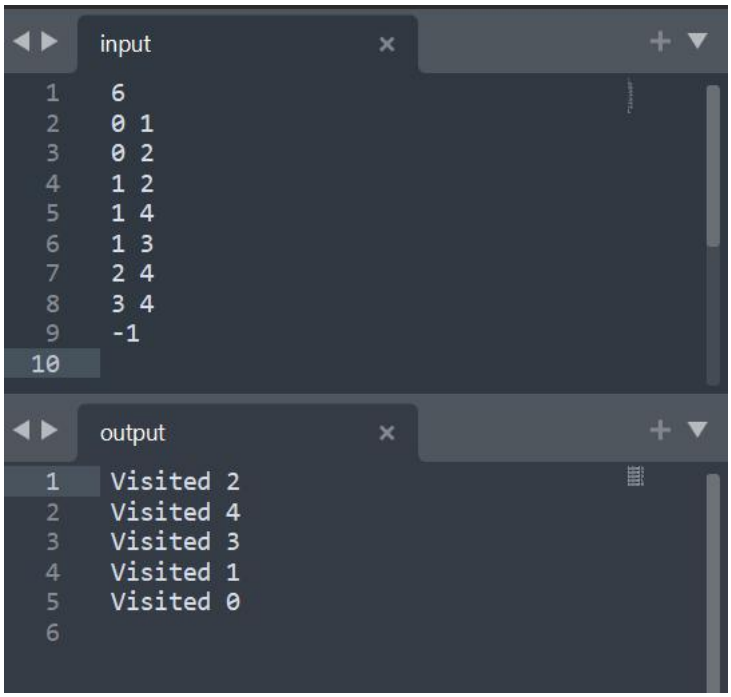
```
#include <stdio.h>
#include <stdlib.h>

#define sf(x)          scanf("%d", &x)
#define pf             printf
#define pfs(x)         printf("%d ", x)
#define pfn(x)         printf("%d\n", x)
#define pfc(x)         printf("%d, ", x)
#define FI(i,x,y,inc)   for(int i = x; i < y; i += inc)
#define F(i,x,y)       FI(i, x, y, 1)
#define F0(i,n)        FI(i, 0, n, 1)
#define RF(i,x,y)       for(int i = x; i >= y; i--)
#define pfarr(i,a,n)    for(int i = 0; i < n-1; i++) pfs(a[i]); pfn(a[n-1]);

void i_o_from_file() {
#ifndef ONLINE_JUDGE
   freopen("C:\\Users\\KIIT\\input", "r", stdin);
   freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}
struct node {
   int vertex;
   struct node* next;
};
```

```
struct node* createNode(int v);
struct Graph {
    int numVertices;
    int* visited;

    // We need int** to store a two dimensional array.
    // Similary, we need struct node** to store an array of Linked lists
    struct node** adjLists;
};
// DFS algo
void DFS(struct Graph* graph, int vertex) {
    struct node* adjList = graph->adjLists[vertex];
    struct node* temp = adjList;
    graph->visited[vertex] = 1;
    printf("Visited %d \n", vertex);

    while (temp != NULL) {
        int connectedVertex = temp->vertex;

        if (graph->visited[connectedVertex] == 0) {
            DFS(graph, connectedVertex);
        }
        temp = temp->next;
    }
}
struct node* createNode(int v) {
    struct node* newNode = malloc(sizeof(struct node));
    newNode->vertex = v;
    newNode->next = NULL;
    return newNode;
}
```

```
struct Graph* createGraph(int vertices) {
    struct Graph* graph = malloc(sizeof(struct Graph));
    graph->numVertices = vertices;

    graph->adjLists = malloc(vertices * sizeof(struct node*));

    graph->visited = malloc(vertices * sizeof(int));

    int i;
    for (i = 0; i < vertices; i++) {
        graph->adjLists[i] = NULL;
        graph->visited[i] = 0;
    }
    return graph;
}
// Add edge
void addEdge(struct Graph* graph, int src, int dest) {
    // Add edge from src to dest
    struct node* newNode = createNode(dest);
    newNode->next = graph->adjLists[src];
    graph->adjLists[src] = newNode;

    // Add edge from dest to src
    newNode = createNode(src);
    newNode->next = graph->adjLists[dest];
    graph->adjLists[dest] = newNode;
}
int main() {
    i_o_from_file();
    /* ****************************************** */

    int v;
```

```
    sf(v);
    struct Graph* graph = createGraph(v);

    while (1) {
        int a, b;
        sf(a);

        if (a == -1) {
            break;
        }
        sf(b);
        addEdge(graph, a, b);
    }
    DFS(graph, 2);

    return 0;
}
```

Output



2. Write a C program to check whether a given graph is connected or not using DFS method.

Program

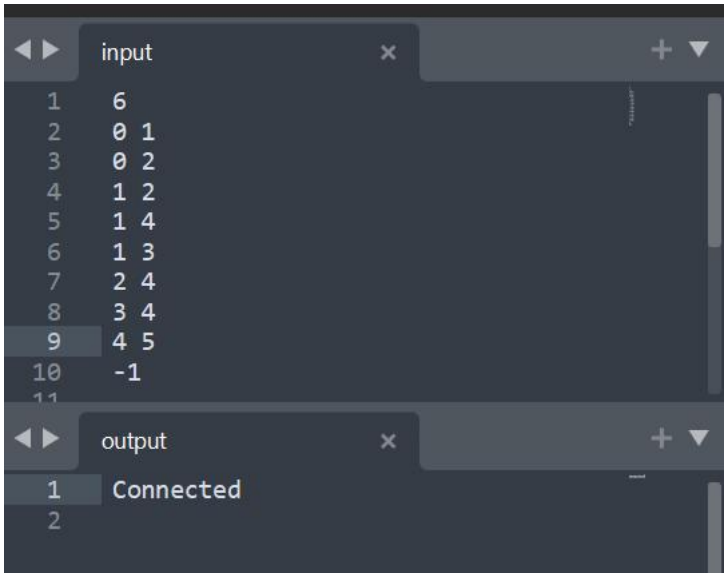
```
#include <stdio.h>
#include <stdlib.h>

#define sf(x)          scanf("%d", &x)

int n = 0;
void i_o_from_file() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}
struct node {
    int vertex;
    struct node* next;
};
struct node* createNode(int v);
struct Graph {
    int numVertices;
    int* visited;

    // We need int** to store a two dimensional array.
    // Similary, we need struct node** to store an array of Linked lists
    struct node** adjLists;
};
```

```
void DFS(struct Graph* graph, int vertex) {
    struct node* adjList = graph->adjLists[vertex];
    struct node* temp = adjList;

    graph->visited[vertex] = 1;
    n++;

    while (temp != NULL) {
        int connectedVertex = temp->vertex;

        if (graph->visited[connectedVertex] == 0) {
            DFS(graph, connectedVertex);
        }
        temp = temp->next;
    }
}

struct node* createNode(int v) {
    struct node* newNode = malloc(sizeof(struct node));
    newNode->vertex = v;
    newNode->next = NULL;
    return newNode;
}
struct Graph* createGraph(int vertices) {
    struct Graph* graph = malloc(sizeof(struct Graph));
    graph->numVertices = vertices;

    graph->adjLists = malloc(vertices * sizeof(struct node*));

    graph->visited = malloc(vertices * sizeof(int));

    int i;
```

```
    for (i = 0; i < vertices; i++) {
        graph->adjLists[i] = NULL;
        graph->visited[i] = 0;
    }
    return graph;
}

// Add edge
void addEdge(struct Graph* graph, int src, int dest) {
    // Add edge from src to dest
    struct node* newNode = createNode(dest);
    newNode->next = graph->adjLists[src];
    graph->adjLists[src] = newNode;

    // Add edge from dest to src
    newNode = createNode(src);
    newNode->next = graph->adjLists[dest];
    graph->adjLists[dest] = newNode;
}


int main() {
    i_o_from_file();
    /* ********************************************** */

    int v;
    sf(v);
    n = 0;
    struct Graph* graph = createGraph(v);

    while (1) {
        int a, b;
```

```
        sf(a);

        if (a == -1) {
            break;
        }
        sf(b);
        addEdge(graph, a, b);
    }
    DFS(graph, 2);

    if (n == v) {
        printf("Connected\n");
    }
    else {
        printf("Non Connected\n");
    }

    return 0;
}
```

Output



3. Write a C program to check whether a given graph is connected or not using BFS method.

Program

```
// Author: Chaudhary Hamdan
// Generated at: Fri Oct  8 14:06:41 2021

#include <stdio.h>
#include <time.h>
#include <stdlib.h>

#define sf(x)          scanf("%d", &x)
#define SIZE           40

int n = 0;
void i_o_from_file();

struct queue {
        int items[SIZE];
        int front;
        int rear;
};
struct queue* createQueue();
void enqueue(struct queue* q, int);
int dequeue(struct queue* q);
void display(struct queue* q);
int isEmpty(struct queue* q);

struct node {
        int vertex;
        struct node* next;
```

```
};

struct node* createNode(int);

struct Graph {
        int numVertices;
        struct node** adjLists;
        int* visited;
};

void bfs(struct Graph* graph, int startVertex) {
        struct queue* q = createQueue();

        graph->visited[startVertex] = 1;
        enqueue(q, startVertex);

        while (!isEmpty(q)) {
                int currentVertex = dequeue(q);
                n++;

                struct node* temp = graph->adjLists[currentVertex];

                while (temp) {
                        int adjVertex = temp->vertex;

                        if (graph->visited[adjVertex] == 0) {
                                graph->visited[adjVertex] = 1;
                                enqueue(q, adjVertex);
                        }
                        temp = temp->next;
                }
        }
```

```
}

struct node* createNode(int v) {
        struct node* newNode = malloc(sizeof(struct node));
        newNode->vertex = v;
        newNode->next = NULL;
        return newNode;
}

struct Graph* createGraph(int vertices) {
        struct Graph* graph = malloc(sizeof(struct Graph));
        graph->numVertices = vertices;

        graph->adjLists = malloc(vertices * sizeof(struct node*));
        graph->visited = malloc(vertices * sizeof(int));

        int i;
        for (i = 0; i < vertices; i++) {
                graph->adjLists[i] = NULL;
                graph->visited[i] = 0;
        }

        return graph;
}

void addEdge(struct Graph* graph, int src, int dest) {
        // Add edge from src to dest
        struct node* newNode = createNode(dest);
        newNode->next = graph->adjLists[src];
        graph->adjLists[src] = newNode;

        // Add edge from dest to src
```

```
        newNode = createNode(src);
        newNode->next = graph->adjLists[dest];
        graph->adjLists[dest] = newNode;
}

struct queue* createQueue() {
        struct queue* q = malloc(sizeof(struct queue));
        q->front = -1;
        q->rear = -1;
        return q;
}
int isEmpty(struct queue* q) {
        if (q->rear == -1)
                return 1;
        else
                return 0;
}
void enqueue(struct queue* q, int value) {
        if (q->rear == SIZE - 1)
                printf("\nQueue is Full!!");
        else {
                if (q->front == -1)
                        q->front = 0;
                q->rear++;
                q->items[q->rear] = value;
        }
}
int dequeue(struct queue* q) {
        int item;
        if (isEmpty(q)) {
                printf("Queue is empty");
                item = -1;
```

```
    }
    else {
        item = q->items[q->front];
        q->front++;
        if (q->front > q->rear) {
            q->front = q->rear = -1;
        }
    }
    return item;
}

int main() {

    i_o_from_file();
    /* ********************************************** */

    int v;
    sf(v);
    n = 0;

    struct Graph* graph = createGraph(v);

    while (1) {
        int a, b;
        sf(a);

        if (a == -1) {
            break;
        }
        sf(b);
        addEdge(graph, a, b);
    }
```

```
        bfs(graph, 0);

        if (n == v) {
                printf("Connected\n");
        }
        else {
                printf("Non Connected\n");
        }
        return 0;
}

void i_o_from_file() {

#ifndef ONLINE_JUDGE
        freopen("C:\\Users\\KIIT\\input", "r", stdin);
        freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}
```

Output

4. Write a C program to print all the nodes reachable from a given starting node in a given digraph using Depth First Search method.

Program

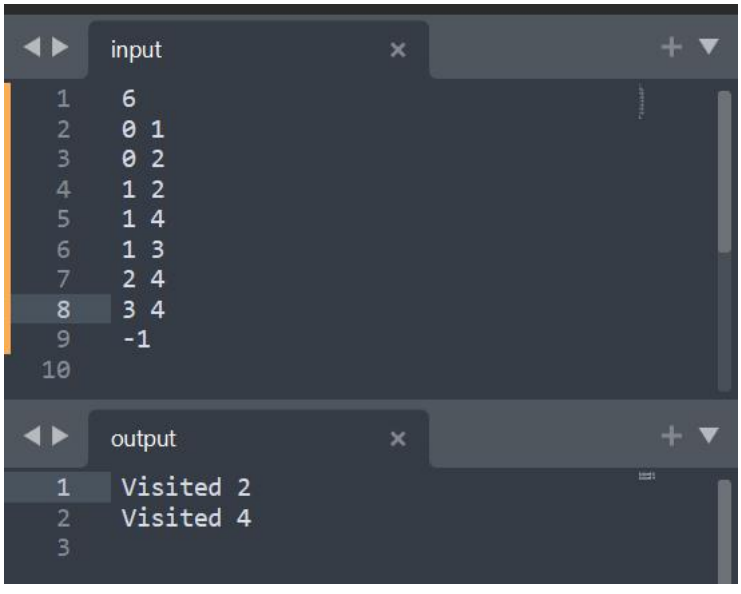
```
// DFS algorithm in C

#include <stdio.h>
#include <stdlib.h>

#define sf(x)          scanf("%d", &x)

void i_o_from_file() {
#ifndef ONLINE_JUDGE
   freopen("C:\\Users\\KIIT\\input", "r", stdin);
   freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}

struct node {
   int vertex;
   struct node* next;
};

struct node* createNode(int v);

struct Graph {
   int numVertices;
   int* visited;
   struct node** adjLists;
};
```

```
void DFS(struct Graph* graph, int vertex) {
    struct node* adjList = graph->adjLists[vertex];
    struct node* temp = adjList;

    graph->visited[vertex] = 1;
    printf("Visited %d \n", vertex);

    while (temp != NULL) {
        int connectedVertex = temp->vertex;

        if (graph->visited[connectedVertex] == 0) {
            DFS(graph, connectedVertex);
        }
        temp = temp->next;
    }
}

// Create a node
struct node* createNode(int v) {
    struct node* newNode = malloc(sizeof(struct node));
    newNode->vertex = v;
    newNode->next = NULL;
    return newNode;
}

// Create graph
struct Graph* createGraph(int vertices) {
    struct Graph* graph = malloc(sizeof(struct Graph));
    graph->numVertices = vertices;

    graph->adjLists = malloc(vertices * sizeof(struct node*));
```

```
    graph->visited = malloc(vertices * sizeof(int));

    int i;
    for (i = 0; i < vertices; i++) {
        graph->adjLists[i] = NULL;
        graph->visited[i] = 0;
    }
    return graph;
}

// Add edge
void addEdge(struct Graph* graph, int src, int dest) {
    // Add edge from src to dest
    struct node* newNode = createNode(dest);
    newNode->next = graph->adjLists[src];
    graph->adjLists[src] = newNode;
}


int main() {


    i_o_from_file();

    /* ********************************************** */

    int v;
    sf(v);


    struct Graph* graph = createGraph(v);
```

```
    while (1) {
        int a, b;
        sf(a);

        if (a == -1) {
            break;
        }

        sf(b);
        addEdge(graph, a, b);
    }


    DFS(graph, 2);

    return 0;
}
```

Output



5. Write an algorithm to print all the nodes reachable from a given starting node in a digraph using BFS method.

Program

```
// Author: Chaudhary Hamdan
// Generated at: Fri Oct  8 14:06:41 2021

#include <stdio.h>
#include <time.h>
#include <stdlib.h>

#define sf(x)          scanf("%d", &x)
#define SIZE            40

void i_o_from_file();

struct queue {
   int items[SIZE];
   int front;
   int rear;
};

struct queue* createQueue();
void enqueue(struct queue* q, int);
int dequeue(struct queue* q);
void display(struct queue* q);
int isEmpty(struct queue* q);

struct node {
   int vertex;
   struct node* next;
};
```

```
struct node* createNode(int);

struct Graph {
    int numVertices;
    struct node** adjLists;
    int* visited;
};

void bfs(struct Graph* graph, int startVertex) {
    struct queue* q = createQueue();

    graph->visited[startVertex] = 1;
    enqueue(q, startVertex);

    while (!isEmpty(q)) {
        int currentVertex = dequeue(q);
        printf("Visited %d\n", currentVertex);

        struct node* temp = graph->adjLists[currentVertex];

        while (temp) {
            int adjVertex = temp->vertex;

            if (graph->visited[adjVertex] == 0) {
                graph->visited[adjVertex] = 1;
                enqueue(q, adjVertex);
            }
            temp = temp->next;
        }
    }
}
```

```
struct node* createNode(int v) {
    struct node* newNode = malloc(sizeof(struct node));
    newNode->vertex = v;
    newNode->next = NULL;
    return newNode;
}

struct Graph* createGraph(int vertices) {
    struct Graph* graph = malloc(sizeof(struct Graph));
    graph->numVertices = vertices;

    graph->adjLists = malloc(vertices * sizeof(struct node*));
    graph->visited = malloc(vertices * sizeof(int));

    int i;
    for (i = 0; i < vertices; i++) {
        graph->adjLists[i] = NULL;
        graph->visited[i] = 0;
    }

    return graph;
}

void addEdge(struct Graph* graph, int src, int dest) {
    // Add edge from src to dest
    struct node* newNode = createNode(dest);
    newNode->next = graph->adjLists[src];
    graph->adjLists[src] = newNode;

}
```

```
struct queue* createQueue() {
    struct queue* q = malloc(sizeof(struct queue));
    q->front = -1;
    q->rear = -1;
    return q;
}

int isEmpty(struct queue* q) {
    if (q->rear == -1)
        return 1;
    else
        return 0;
}

void enqueue(struct queue* q, int value) {
    if (q->rear == SIZE - 1)
        printf("\nQueue is Full!!");
    else {
        if (q->front == -1)
            q->front = 0;
        q->rear++;
        q->items[q->rear] = value;
    }
}

int dequeue(struct queue* q) {
    int item;
    if (isEmpty(q)) {
        printf("Queue is empty");
        item = -1;
    }
    else {
```

```
        item = q->items[q->front];
        q->front++;
        if (q->front > q->rear) {
            q->front = q->rear = -1;
        }
    }
    return item;
}


int main() {

    i_o_from_file();

    /* ********************************************** */

    int v;
    sf(v);


    struct Graph* graph = createGraph(v);

    while (1) {
        int a, b;
        sf(a);

        if (a == -1) {
            break;
        }

        sf(b);
        addEdge(graph, a, b);
```

```
    }


    bfs(graph, 0);


    return 0;
}

void i_o_from_file() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}
```

Output