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**Experiment No. 9: Depth First Search and Breath First Search**

**Aim : Implementation of DFS and BFS traversal of graph.**

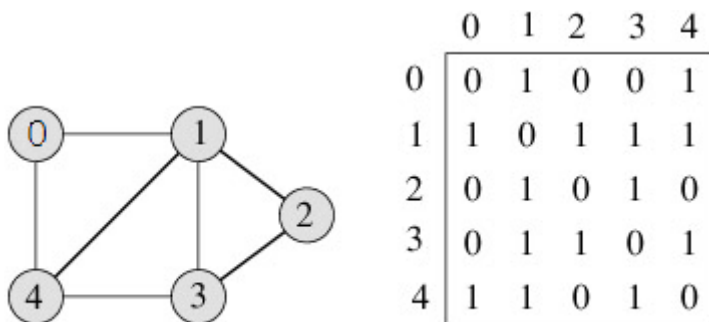
**Objective:**

1. Understand the Graph data structure and its basic operations.
2. Understand the method of representing a graph.
3. Understand the method of constructing the Graph ADT and defining its operations

**Theory:**

A graph is a collection of nodes or vertex, connected in pairs by lines referred as edges. A graph can be directed or undirected graph.

One method of traversing through nodes is depth first search. Here we traverse from starting node and proceeds from top to bottom. At a moment we reach a dead end from where the further movement is not possible and we backtrack and then proceed according to left right order. A stack is used to keep track of a visited node which helps in backtracking.



**DFS Traversal –0 1 2 3 4**

**Algorithm**

Algorithm: DFS\_LL(V)

Input: V is a starting vertex

Output : A list VISIT giving order of visited vertices during traversal.

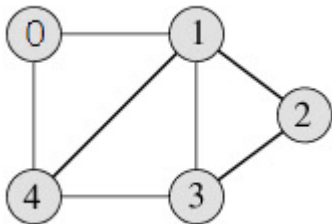
Description: linked structure of graph with gptr as pointer

1. if gptr = NULL then  
    print "Graph is empty" exit
2. u=v



3. OPEN.PUSH(u)
4. while OPEN.TOP !=NULL do
  - u=OPEN.POP()
  - if search(VISIT,u) = FALSE then
    - INSERT\_END(VISIT,u)
    - Ptr = gptr(u)
    - While ptr.LINK != NULL do
      - Vptr = ptr.LINK
      - OPEN.PUSH(vptr.LABEL)
  - End while
- End if
- End while
5. Return VISIT
6. Stop

### BFS Traversal



	0	1	2	3	4
0	0	1	0	0	1
1	1	0	1	1	1
2	0	1	0	1	0
3	0	1	1	0	1
4	1	1	0	1	0

### BFS Traversal – 0 1 4 2 3

#### Algorithm

Algorithm: DFS()

i=0

count=1

visited[i]=1

print("Visited vertex i")



repeat this till queue is empty or all nodes visited

repeat this for all nodes from first till last

```
if(g[i][j]!=0&&visited[j]!=1)
```

```
{
```

```
push(j)
```

```
}
```

```
i=pop()
```

```
print("Visited vertex i")
```

```
visited[i]=1
```

```
count++
```

Algorithm: BFS()

```
i=0
```

```
count=1
```

```
visited[i]=1
```

```
print("Visited vertex i")
```

repeat this till queue is empty or all nodes visited

repeat this for all nodes from first till last

```
if(g[i][j]!=0&&visited[j]!=1)
```

```
{
```

```
enqueue(j)
```

```
}
```

```
i=dequeue()
```

```
print("Visited vertex i")
```

```
visited[i]=1
```

```
count++
```

**Code:**

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

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

```
// Define the maximum number of vertices in the graph
```



```
#define MAX_VERTICES 100

// Define a stack for DFS and a queue for BFS

int stack[MAX_VERTICES];

int top = -1;

int queue[MAX_VERTICES];

int front = -1, rear = -1;

int visited[MAX_VERTICES];

// Define the adjacency matrix for the graph

int graph[MAX_VERTICES][MAX_VERTICES];

int numVertices;

void push(int vertex) {
    stack[++top] = vertex;
}

int pop() {
    return stack[top--];
}

void enqueue(int vertex) {
    if (rear == MAX_VERTICES - 1)
        printf("Queue is full.\n");
```



```
else

    queue[++rear] = vertex;

}

int dequeue() {

    if (front == rear)

        return -1; // Empty queue

    return queue[++front];

}

void initGraph(int vertices) {

    numVertices = vertices;

    for (int i = 0; i < numVertices; i++) {

        visited[i] = 0;

        for (int j = 0; j < numVertices; j++) {

            graph[i][j] = 0;

        }

    }

}

void addEdge(int start, int end) {

    graph[start][end] = 1;

}

void DFS(int vertex) {
```



```
int u, v;

push(vertex);

while (top != -1) {
    u = pop();
    if (visited[u] == 0) {
        printf("Visited vertex %d\n", u);
        visited[u] = 1;
        for (v = 0; v < numVertices; v++) {
            if (graph[u][v] && !visited[v]) {
                push(v);
            }
        }
    }
}
```

```
void BFS(int vertex) {
    int u, v;
    enqueue(vertex);

    while (front != rear) {
        u = dequeue();
        if (visited[u] == 0) {
            printf("Visited vertex %d\n", u);
```

```
visited[u] = 1;

for (v = 0; v < numVertices; v++) {

    if (graph[u][v] && !visited[v]) {

        enqueue(v);

    }

}

}

}
```

```
int main() {

    int vertices, edges, startVertex;


    printf("Enter the number of vertices and edges: ");

    scanf("%d %d", &vertices, &edges);

    initGraph(vertices);


    printf("Enter the edges (format: start end):\n");

    for (int i = 0; i < edges; i++) {

        int start, end;

        scanf("%d %d", &start, &end);

        addEdge(start, end);

    }


    printf("Enter the starting vertex for traversal: ");
```



```
scanf("%d", &startVertex);

printf("DFS Traversal:\n");

DFS(startVertex);

// Reset visited array
for (int i = 0; i < vertices; i++) {
    visited[i] = 0;
}

printf("\nBFS Traversal:\n");

BFS(startVertex);

return 0;
}
```

### Output:

```
Enter the number of vertices and edges: 4 5
Enter the edges (format: start end):
2 3
4 5
6 9
8 7
0 1
Enter the starting vertex for traversal: 2
DFS Traversal:
Visited vertex 2
Visited vertex 3

BFS Traversal:
Visited vertex 2
Visited vertex 3

...Program finished with exit code 0
Press ENTER to exit console.□
```





### **Conclusion:**

- DFS (Depth-First Search): It explores a graph by delving as deep as possible along each branch before backtracking. It is useful for discovering connected components within a graph.
- BFS (Breadth-First Search): This method explores a graph level by level, making it suitable for finding the shortest path and exploring neighbors.

Both DFS and BFS are indispensable tools for various computer science applications, from pathfinding to network analysis and graph-related problem solving. The choice between them depends on the specific problem and objectives.