| Experiment No.9 |
| --- |
| Implementation of Graph traversal techniques - Depth First Search, Breadth First Search |
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| Marks: |
| Sign: |

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

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

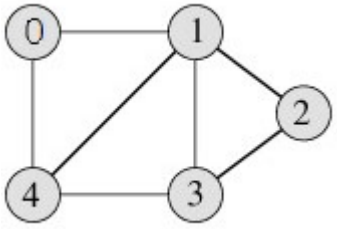
**Objective:**

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 vertices, connected in pairs by lines referred to as edges. A graph can be directed or undirected.

One method of traversing through nodes is depth first search. Here we traverse from the starting node and proceed 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.




| | 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 |

**DFS Traversal –0 1 2**

**3 4**

**Algorithm**

Algorithm: DFS_LL(V)

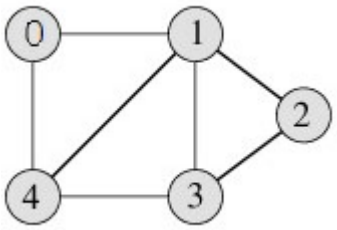
Input: V is a starting vertex

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:**

# Dfs

```
#include <stdio.h>

#define MAX 5

void depth_first_search(int adj[][MAX],int visited[],int start)

{

        int stack[MAX];

int top = - 1, i;

printf("%c-",start + 65);

visited[start] = 1;

stack[++top] = start;

while(top!= -1)

{

 start = stack[top];
```

```
                    for(i = 0; i < MAX; i++)
{
        if(adj[start][i] && visited[i] == 0)
{
 stack[++top] = i;
printf("%c-", i + 65);
visited[i] = 1;
break;
 }
 }
                    if(i == MAX)
 top--;
}
}
int main()
{
        int adj[MAX][MAX];
        int visited[MAX] = {0}, i, j;
printf("\n Enter the adjacency matrix: ");
        for(i = 0; i < MAX; i++)
                for(j = 0; j < MAX; j++)
 scanf("%d", &adj[i][j]);
printf("DFS Traversal: ");
        depth_first_search(adj,visited,0);
printf("\n");
```

```
        return 0;
}
```

# Bfs

```
#include <stdio.h>
#define MAX 10
void breadth_first_search(int adj[][MAX],int visited[],int start)
{
        int queue[MAX],rear =-1,front =-1, i;
queue[++rear] = start;
visited[start] = 1;
while(rear != front)
{
 start = queue[++front];
 if(start == 4)
 printf("5\t");
 else
 printf("%c \t",start + 65);
                for(i = 0; i < MAX; i++)
 {
                        if(adj[start][i] == 1 && visited[i] == 0)
 {
 queue[++rear] = i;
visited[i] = 1;
```

```
 }
 }
}
}
int main()
{
        int visited[MAX] = {0};
        int adj[MAX][MAX], i, j;
printf("\n Enter the adjacency matrix: ");
        for(i = 0; i < MAX; i++)
                for(j = 0; j < MAX; j++)
 scanf("%d", &adj[i][j]);
breadth_first_search(adj,visited,0);
        return 0;
}
```

**Output:**

**dfs**


**Bfs**


**Conclusion:**

1)Write the graph representation used by your program and explain why you choose that.

The program uses an adjacency matrix to represent the graph. An adjacency matrix is a 2D array where each cell adj[i][j] represents an edge between vertex i and vertex j. The value in the cell indicates the presence (usually 1) or absence (usually 0) of an edge. This representation was chosen because it provides a simple and straightforward way to implement both depth-first search (DFS) and breadth-first search (BFS) algorithms. It allows for easy traversal and checking of connections between nodes. However, it may not be the most memory-efficient representation for sparse graphs.

2) Write the applications of BFS and DFS other than finding connected nodes and explain how it is attained?

**Applications of BFS:**

1. **Shortest Path and Distance Calculation:** BFS can be used to find the shortest path between two nodes in an unweighted graph. It's often applied in navigation systems to find the shortest route between two locations, assuming equal travel time for each edge.
2. **Connected Components:** While BFS is commonly used for finding connected nodes, it can also be applied to find connected components in a graph, which are subsets of nodes where every node can be reached from any other node within the subset.
3. **Bipartite Graph Detection:** BFS can determine whether a graph is bipartite (can be divided into two sets of nodes where no two nodes within the same set are connected). This is achieved by checking if a cycle of odd length exists while traversing the graph.
4. **Web Crawling:** Search engines and web crawlers use BFS to index web pages by following links. The BFS algorithm ensures that pages on the same level (distance from the starting page) are crawled before moving to deeper levels.

**Applications of DFS:**

1. **Topological Sorting:** DFS is used to perform topological sorting in directed acyclic graphs (DAGs). This is essential in scheduling tasks with dependencies, such as in project management.
2. **Cycle Detection:** DFS can identify cycles in a graph. It is used in applications like deadlock detection in operating systems or detecting dependencies in software development.
3. **Pathfinding Algorithms:** In maze solving or game development, DFS can be applied to explore possible paths until a goal is reached or to discover alternative routes.

4. **Connected Components and Strongly Connected Components:** While BFS can find connected components, DFS is used to find strongly connected components (SCCs) in a directed graph. SCCs are used in many applications, including compiler optimization and social network analysis