Experiment No.9
Implementation of Graph traversal techniques - Depth First Search, Breadth First Search
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Experiment No. 9: Depth First Search and Breath First Search

Aim : Implementation of DFS and BFS traversal of graph.

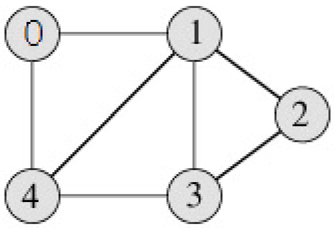
Objective:

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 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)

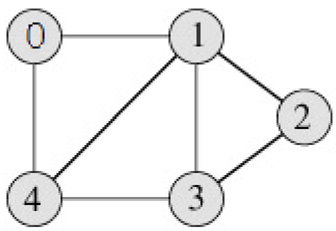
Input: V is a starting vertex

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 employs an adjacency matrix to depict the graph's structure. This matrix is essentially a 2D array where each element adj[i][j] signifies whether there is an edge connecting vertex i to vertex j. Typically, a value of 1 indicates the presence of an edge, while 0 implies its absence. The choice of using an adjacency matrix was based on its simplicity and suitability for implementing depth-first search (DFS) and breadth-first search (BFS) algorithms. This representation offers a straightforward means of navigating the graph and verifying relationships between nodes. However, it may not be the most memory-efficient choice when dealing with graphs that have relatively few connections or edges.

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

- BFS and DFS have various applications beyond finding connected nodes:

BFS (Breadth-First Search):

- Shortest Path: Finds the shortest path in unweighted graphs by exploring nodes level by level.
- Minimal Spanning Tree: Determines the minimal spanning tree of unweighted graphs.
- Bipartite Graph Detection: Identifies bipartite graphs.
- Web Crawling: Used for systematic web page exploration in search engines.

DFS (Depth-First Search):

- Topological Sorting: Orders nodes in a directed acyclic graph.
- Cycle Detection: Detects cycles in graphs.
- Maze Solving: Pathfinding in mazes and puzzles.
- Connected Components: Identifies connected subgraphs.
- Game Solving: Used in game and puzzle solving.

Both BFS and DFS can be achieved using iterative or recursive techniques, depending on the problem and the order of node exploration.