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Artificial Intelligence Lab

Exercise 4: Depth First Search and Breadth-First Search

AIM: To implement a depth-first search and breadth-first search

INTRODUCTION:

What is depth-first search (DFS)?

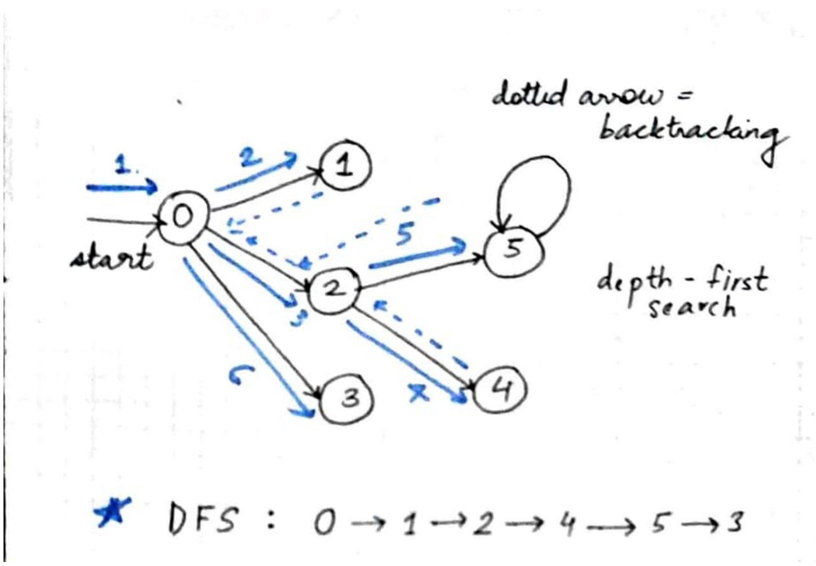
Depth-first search is an algorithm for traversing or searching tree or graph data structures. The algorithm starts at the root node (selecting some arbitrary node as the root node in the case of a graph) and explores as far as possible along each branch before backtracking.

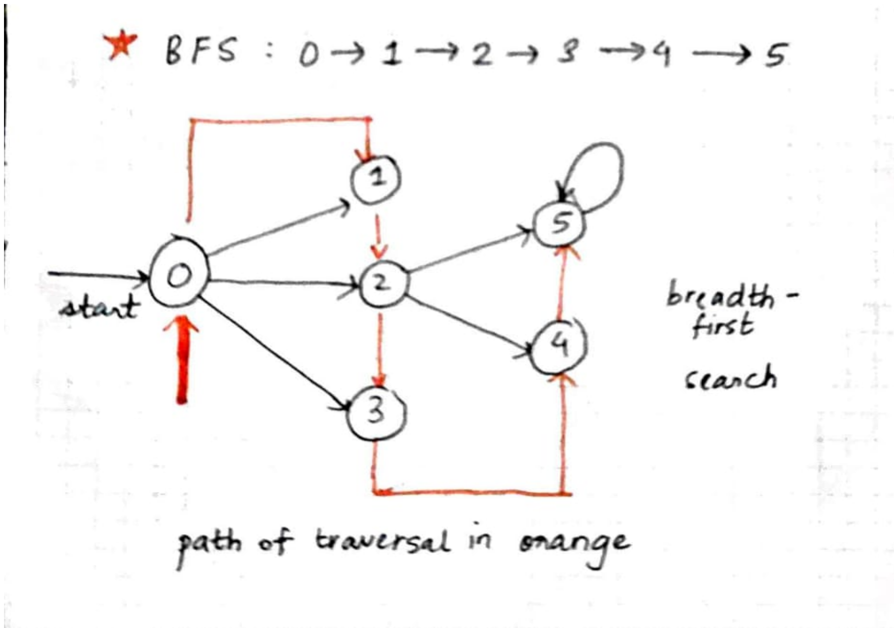
What is bread-first search (BFS)?

Breadth-first search is a graph traversal algorithm that starts traversing the graph from the root node and explores all the neighboring nodes. Then, it selects the nearest node and explores all the unexplored nodes. While using BFS for traversal, any node in the graph can be considered as the root node.

DEMONSTRATION:

Both of the above algorithms can be executed by the example of a simple directed graph.





ALGORITHM FOR DFS:

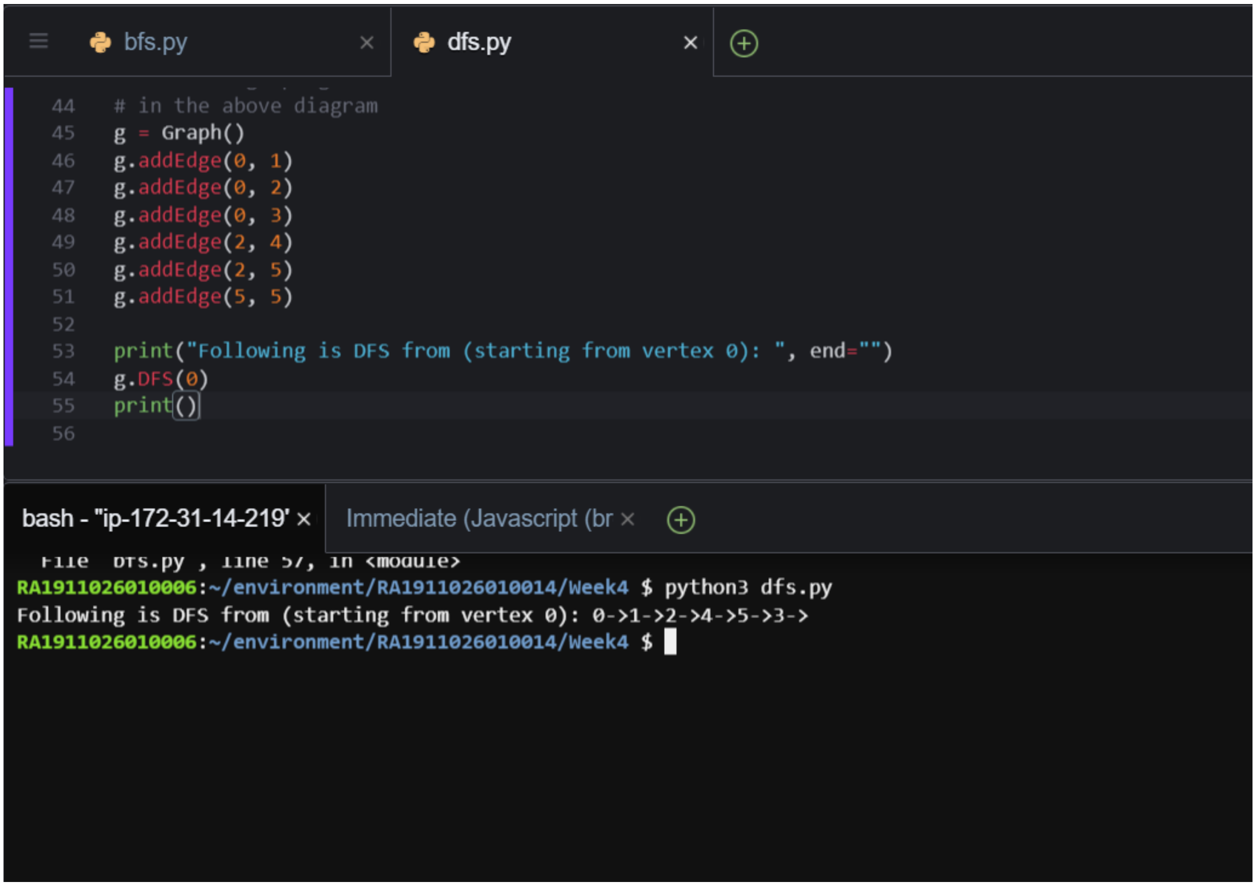
1. Take an input as a graph or tree.
2. Create a recursive function to mark the nodes.
3. Select an arbitrary node in the graph as the root node.
4. Move to an adjacent unmarked node.
5. Mark it as visited and add to an array.
6. Continue 4 and 5 till there are no unmarked nodes.
7. Then backtrack and call the recursive function on the next unmarked node.
8. Repeat 7 till all nodes are marked.
9. Print the final array as the path.

PROGRAM FOR DFS:

```
from collections import defaultdict

# This class represents a directed graph using
# adjacency list representation
class Graph:
	def __init__(self):
		# default dictionary to store graph
		self.graph = defaultdict(list)

	# function to add an edge to graph
	def addEdge(self, u, v):
```

```
        self.graph[u].append(v)

    # A function used by DFS
    def DFSUtil(self, v, visited):

        # Mark the current node as visited and print it
        visited.add(v)
        print(v, end=' ')

        # Recur for all the vertices adjacent to this vertex
        for neighbour in self.graph[v]:
            if neighbour not in visited:
                self.DFSUtil(neighbour, visited)

    # The function to do DFS traversal. It uses recursive DFSUtil()
    def DFS(self, v):
        # Create a set to store visited vertices
        visited = set()

        # Call the recursive helper function
        # to print DFS traversal
        self.DFSUtil(v, visited)

g = Graph()
g.addEdge(0, 1)
g.addEdge(0, 2)
g.addEdge(0, 3)
g.addEdge(2, 4)
g.addEdge(2, 5)
g.addEdge(5, 5)

print("Following is DFS from (starting from vertex 0)")
g.DFS(0)
```

OUTPUT FOR DFS:



ALGORITHM FOR BFS:

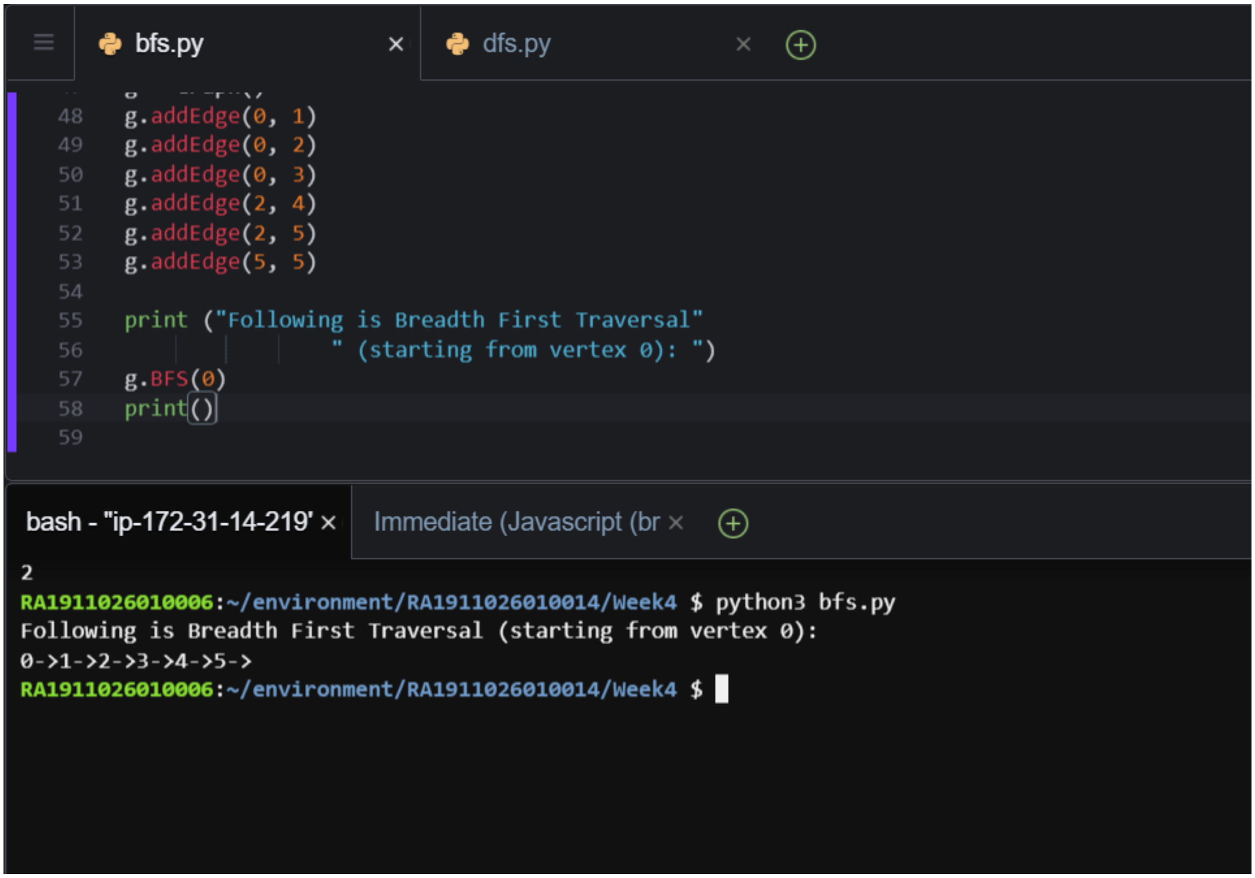
1. Start by putting any one of the graph's vertices at the back of a queue.
2. Take the front item of the queue and add it to the visited list.
3. Create a list of that vertex's adjacent nodes. Add the ones which aren't in the visited list to the back of the queue.
4. Keep repeating steps 2 and 3 until the queue is empty.

PROGRAM FOR BFS:

```
from collections import defaultdict
class Graph:
    def __init__(self):
        self.graph = defaultdict(list)

    # function to add an edge to graph
    def addEdge(self,u,v):
```

```
            self.graph[u].append(v)

      # Function to print a BFS of graph
      def BFS(self, s):
            # Mark all the vertices as not visited
            visited = [False] * (max(self.graph) + 1)
            queue = [] # Create a queue for BFS

            # Mark the source node as visited and enqueue it
            queue.append(s)
            visited[s] = True

            while queue:
                  # Dequeue a vertex from queue and print it
                  s = queue.pop(0)
                  print (s, end = " ")

                  # 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 in self.graph[s]:
                        if visited[i] == False:
                              queue.append(i)
                              visited[i] = True

g = Graph()
g.addEdge(0, 1)
g.addEdge(0, 2)
g.addEdge(0, 3)
g.addEdge(2, 4)
g.addEdge(2, 5)
g.addEdge(5, 5)

print("Following is Breadth First Traversal"
                        (starting from vertex 0): ")
g.BFS(0)
```

OUTPUT FOR BFS:



OBSERVATION:

From the above algorithms, we can see the different types of search techniques or traversals that can be applied to a tree or graph.

RESULT:

Depth-first search and breadth-first search algorithms were implemented successfully.