Breadth First Search

Definition

A breadth first search is a recursive algorithm for searching all vertices of a graph or tree data structure.
The vertices of the graph are categorized between:

1. Visited
2. Unvisited

The point of BFS is to mark each vertex as visited while avoiding cycles.

Pseudocode

Iterative Solution:

```
create a queue Q
function bfs(v):
        visited[v] = true
        push v into Q
        while Q is not empty do:
                u = q.pop()
                if u is not visited do:
                        visited[u] = true
                for node in neighbors(u) do:
                        q.push(node)
```

Recursive Solution:

```
level = [v]
function bfs(level):
        next_level = []
        for node in level:
                for neighbor in neighbors(node):
                        if node is visited:
                                visited[neighbor] = true
                                next_level.append(neighbor)
        bfs(next_level)
```

Algorithm Description

1. Start by pushing an arbitrary vertex into the queue.
2. Pop from the front of the queue and add it to the visited list.
3. Create a list of the vertex's adjacent nodes. Add the unvisited to the queue.
4. Repeat steps 2 and 3 until the queue is empty.

Time Complexity

The worst time complexity is O(V + E).