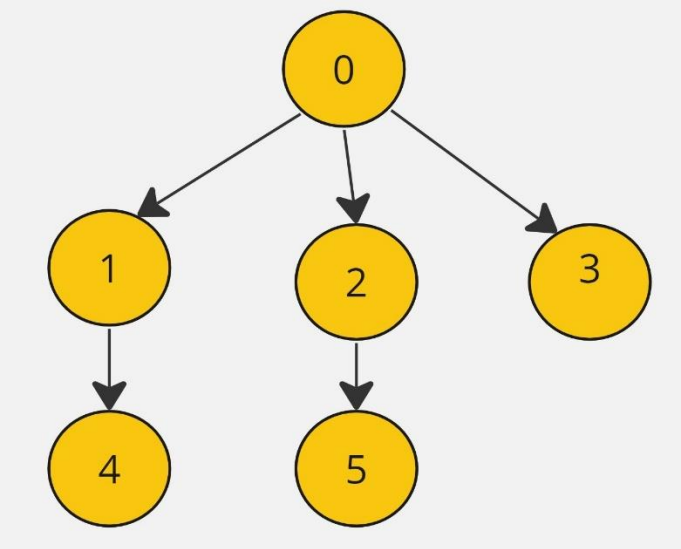
Breadth First Search Traversal of Graph CodeStudio

The program employs Breadth-First Search (BFS) traversal to explore the graph efficiently, even when there are disconnected components. The bfsOfGraph function initializes a queue for BFS, marking visited nodes and exploring neighbors in a level-wise manner.

Example:



Output: 0, 1, 2, 3, 4, 5

AddEdge function:

- **Purpose:**
    - Populates the graph's adjacency list based on the provided edge list.
- **Explanation:**
    - Iterates through each edge in the **edges** vector.
    - For each edge, extracts the source vertex **u** and iterates over the connected vertices.
    - Adds an edge from **u** to **v** in the adjacency list.
    - If the graph is undirected, adds an edge from **v** to **u** as well.
- **Time Complexity:**
    - **O(E), where E is the number of edges in the input vector.**
- **Space Complexity:**

- **O(E), where E is the number of edges. Each edge results in the creation of one or two entries in the adjacency list.**

Approach 1: Function to print the BFS Traversal of the Graph

- **Purpose:**
  - Performs Breadth-First Search (BFS) traversal on the graph.
- **Explanation:**
  - Initializes a visited map to track visited nodes.
  - Initializes a **bfsTraversal** vector to store the result of BFS traversal.
  - Initializes a queue (**bfsQueue**) for BFS.
  - Iterates through each node in the graph (necessary for handling disconnected components).
  - For each unvisited node, starts BFS from that node.
  - In the BFS loop, explores neighbors of the current node, adding them to the queue if not visited.
  - Constructs a temporary vector (**temp**) representing the BFS traversal component.
  - Adds the component to the overall result.
- **Time Complexity:**
  - **O(V + E), where V is the number of vertices and E is the number of edges. Accounts for the traversal of all vertices and edges, even in the presence of disconnected components.**
- **Space Complexity:**
  - **O(V + E), where V is the number of vertices and E is the number of edges. Includes space for the visited map, BFS traversal result vector, and queue.**

Overall Time and Space Complexity:

- **Overall Time Complexity:**
  - **Using addEdge: O(V + E) for both connected graphs and graphs with disconnected components.**

    - **Without addEdge (only BFS): O(V) for the BFS traversal alone.**
- **Overall Space Complexity:**
    - **O(V + E), considering the adjacency list, visited map, and auxiliary data structures in the bfsOfGraph function.**