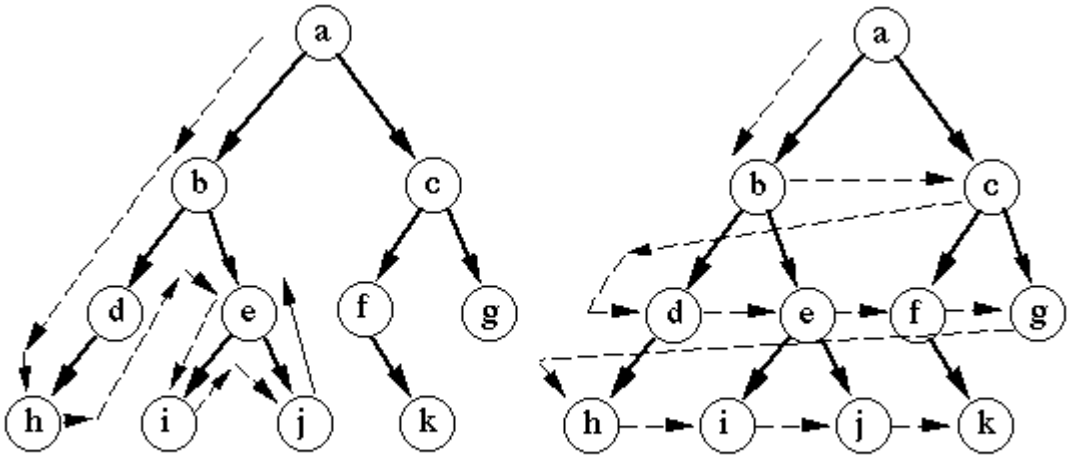
Breadth First Search

💡 **Breadth First Search (BFS)** is a fundamental **graph traversal algorithm.**

→ Traversal means visiting all the nodes of a graph. Breadth First Traversal or Breadth First Search is a recursive algorithm for searching all the vertices of a graph or tree data structure.

→ It begins with a node, then first traverses all its adjacent. Once all adjacent are visited, then their adjacent are traversed.



Steps Of The Algorithm

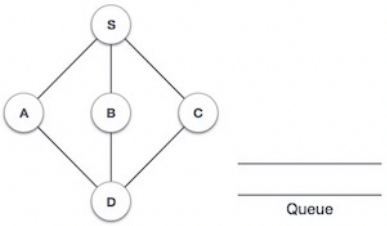
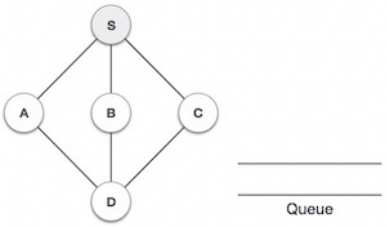
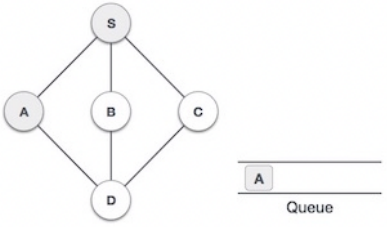
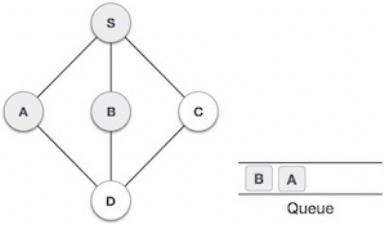
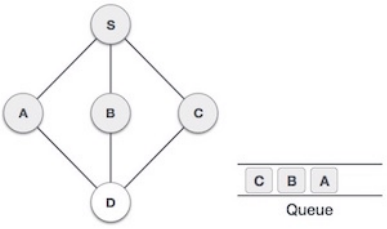
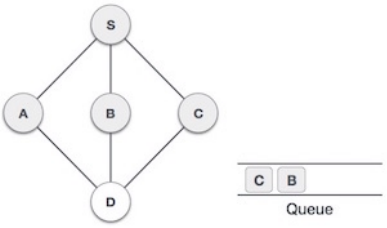
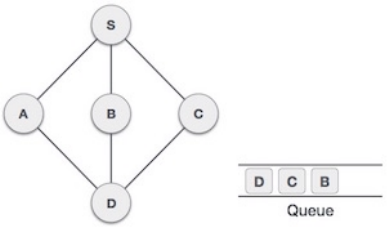
The algorithm starts from a given source and explores all reachable vertices from the given source and puts each vertex of the graph into one of two categories:

1. Visited
2. Not Visited

The only catch here is that, unlike trees, graphs may contain cycles, so we may come to the same node again. Therefore vertex is marked as visited to avoiding cycles.

The algorithm works as follows:

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.

Step	Traversal	Description
1		Initialize the queue.
2		We start from visiting **S** (starting node), and mark it as visited.
3		We then see an unvisited adjacent node from **S**. In this example, we have three nodes but alphabetically we choose **A**, mark it as visited and enqueue it.
4		Next, the unvisited adjacent node from **S** is **B**. We mark it as visited and enqueue it.
5		Next, the unvisited adjacent node from **S** is **C**. We mark it as visited and enqueue it.
6		Now, **S** is left with no unvisited adjacent nodes. So, we dequeue and find **A**.
7		From **A** we have **D** as unvisited adjacent node. We mark it as visited and enqueue it.

📌 Depth First Search in a way that closest vertices are visited before others. This is the different between DFS and BFS. We mainly traverse vertices level by level in breadth first search.

Pseudocode

```
create a queue Q
mark v as visited and put v into Q
while Q is non-empty
    remove the head u of Q
    mark and enqueue all (unvisited) neighbours of u
```

📌 A graph is a mathematical structure consisting of vertices (nodes) and edges that connect these vertices. A tree is a specific type of graph

Analysis

- The time complexity of the BFS algorithm is represented in the form of O(V + E), where V is the number of nodes and E is the number of edges.

BFS Algorithm Applications

1. For GPS navigation
2. Path finding algorithms
3. Cycle detection in an undirected graph
4. In a peer-to-peer network, BFS algorithm can be used as a traversal method to find all the neighboring nodes. Most torrent clients, such as

BitTorrent, uTorrent, etc. employ this process to find "seeds" and "peers" in the network.

5. BFS can be used in web crawlers to create web page indexes. It is one of the main algorithms that can be used to index web pages. It starts traversing from the source page and follows the links associated with the page. Here, every web page is considered as a node in the graph.
6. BFS is used to determine the shortest path and minimum spanning tree.
7. BFS is also used in Cheney's technique to duplicate the garbage collection.
8. It can be used in ford-Fulkerson method to compute the maximum flow in a flow network.

📌 Java implementation can be found under Implementation_Java folder

📚 References

BFS Graph Algorithm(With code in C, C++, Java and Python)

Breadth first traversal or Breadth first Search is a recursive algorithm for searching all the vertices of a graph or tree data structure. In this tutorial, you will understand the working of bfs algorithm with codes in C, C++, Java, and Python.

https://www.programiz.com/dsa/graph-bfs

Breadth First Search or BFS for a Graph - GeeksforGeeks

A Computer Science portal for geeks. It contains well written, well thought and well explained computer science and programming articles, quizzes and practice/competitive

https://www.geeksforgeeks.org/breadth-first-search-or-bfs-for-a-graph/

BFS (Breadth First Search) — Geniş Öncelikli Arama Algoritmasını Tanıyalım.

Herkese selamlar, uzun soluklu bir aradan sonra deneyimlerimi yeniden paylaşmaya başladım, bundan sonraki yazılarda, öyle tahmin ediyorum...

https://medium.com/tapu-com-bakış-açısı/bfs-breath-first-search-geniş-öncelikli-arama-algoritmasını-tanıyalım-ec7050a41af

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SerhatKumas - Overview

Computer engineering student who loves coding in different fields instead of focusing on a one spesific area. - SerhatKumas

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