DATA STRUCTURES AND ITS APPLICATIONS

Graph Traversal Methods

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Graph Traversal Methods - Topics

- Why we need to traverse the graph?
- Traversing the graph using different techniques
  - ✓ Depth First Search and Breadth First Search Traversal
- Algorithms for Depth First and Breadth First Search Traversal

Graph Traversals

- **Graph traversal**(also known as graph search) refers to the process of visiting/investigating (checking or updating) each vertex of the graph in some systematic order -Wiki

- Traversal can start in any arbitrary vertex

- Traversals are classified by the order in which the vertices are visited

Methods to Traverse the Graph

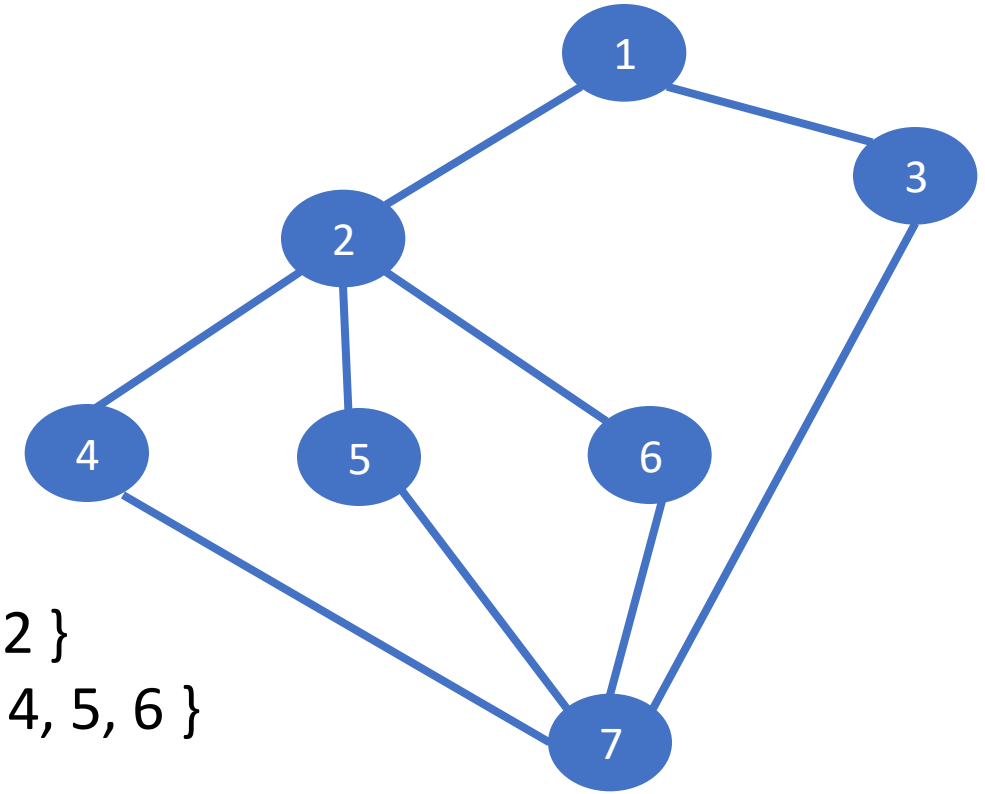
- Depth First Search
- Breadth First Search

Depth first search (DFS)

- Visits all the nodes related to one neighbour before visiting the other neighbours and its related nodes. Once it reaches dead end, it backtracks along previously visited node and continue traversing from there.
- Analogues to pre-order traversal of an ordered tree
- Uses stack behaviour, hence implemented using recursive algorithm

Depth First Search Traversal

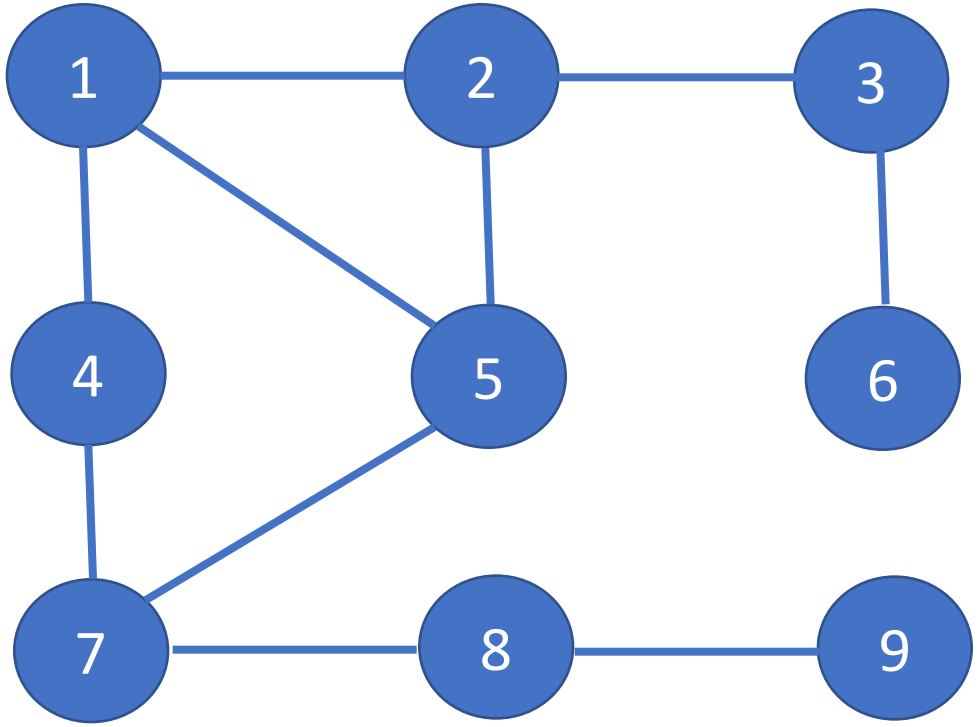
- DFS traverse the depth of the graph, until it cannot go any further at which point it backtracks and continues



V = { 2 }
W= { 4, 5, 6 }

Traversal order : 1 , 2, 4 , 7, 3, 5, 6

Depth First Search Traversal

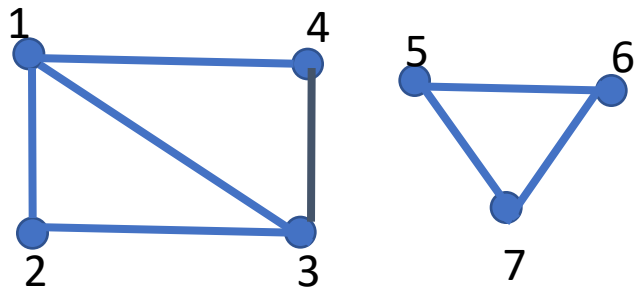


1 2 3 6 5 7 4 8 9

Difficulties in the graph traversals

- **Graph may contain cycles**
  - Traversal algorithm may reach the same vertex second time.
  - To prevent the infinite recursion , we introduce Boolean valued array **visited**
  - Set the **visited[v] to true** once node v is visited
  - Check the **visited[w]** before processing any node w

- **Graph may not be connected:**
  - Traversal algorithm may fail to reach all the nodes from a single starting point



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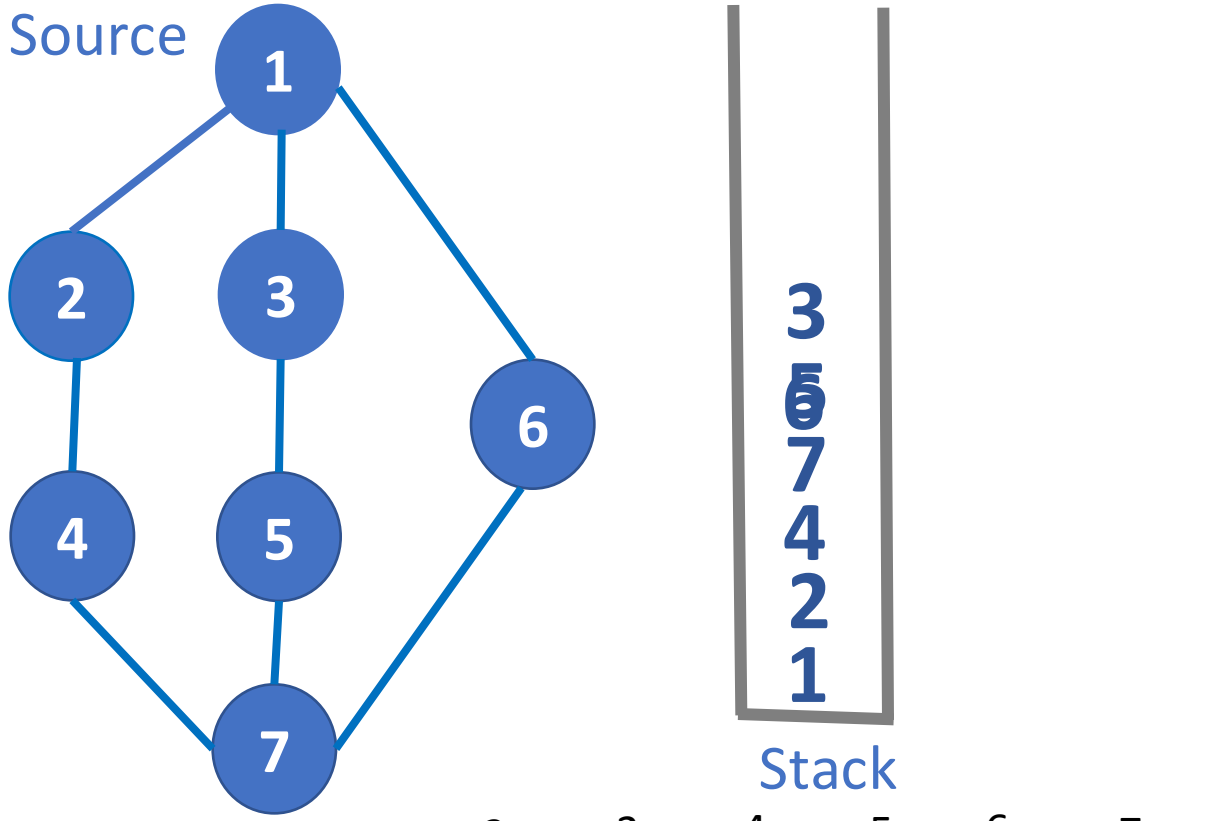
DFS Traversal – Using Stack



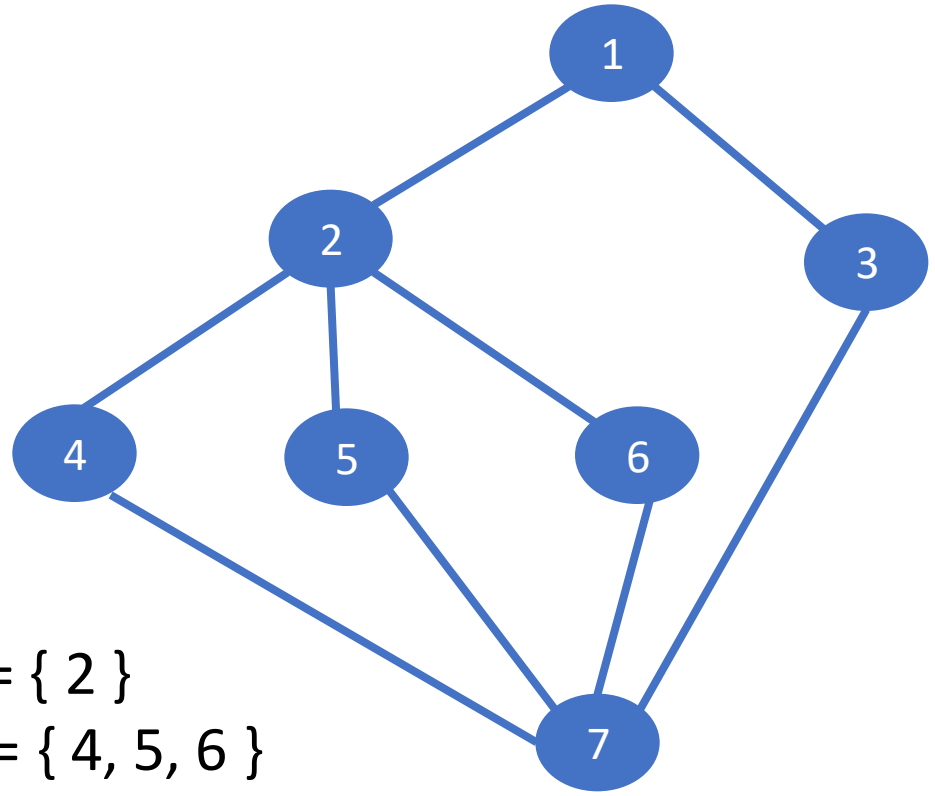
Breadth first search (BFS)

- Explores all the neighbour nodes in first level from an arbitrary node, before moving to next level of neighbouring nodes.

- Uses Queue behaviour

Breadth First Search Traversal

- Analogous to level-by-level traversal of ordered tree



V = { 2 }
W= { 4, 5, 6 }

Traversal order : 1 , 2, 3, 4, 5, 6 , 7

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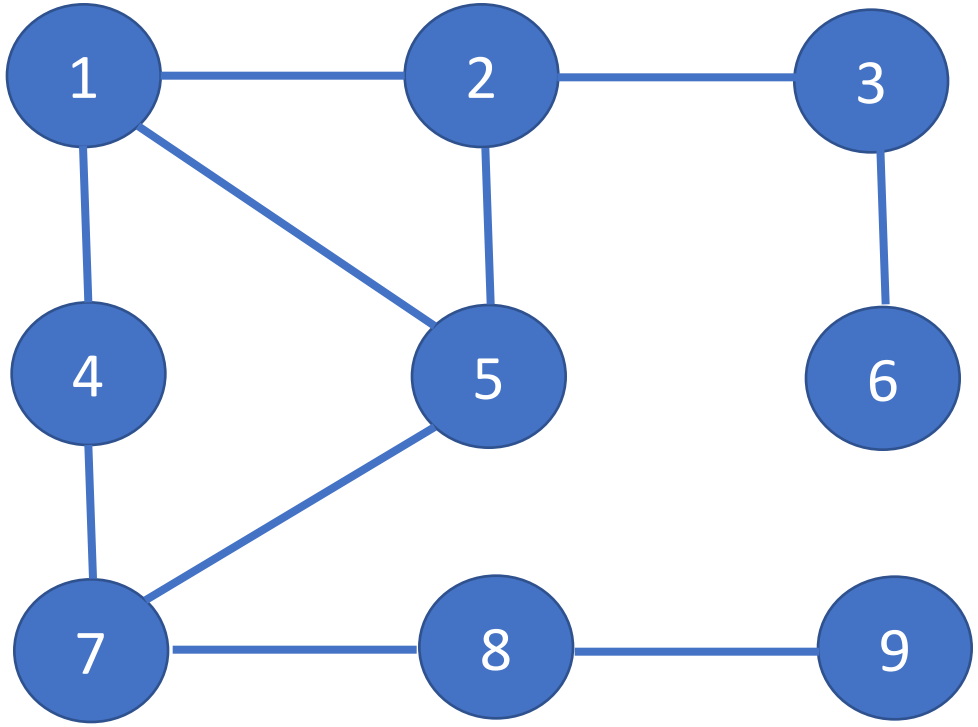
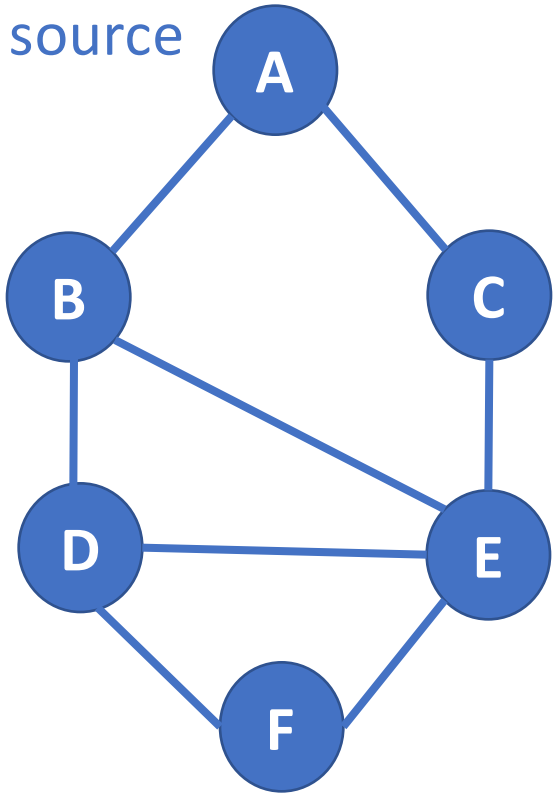
Breadth first search Traversal



BFS Traversal – Using Queue

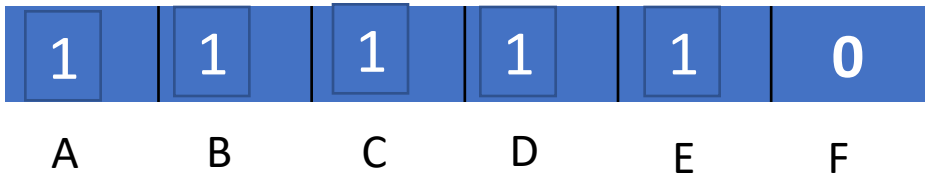


front

Queue

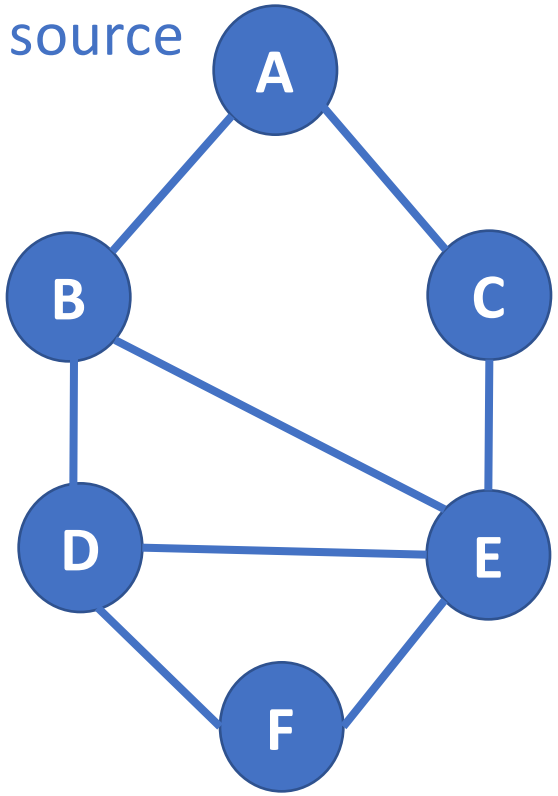
Remove_Q

Visited

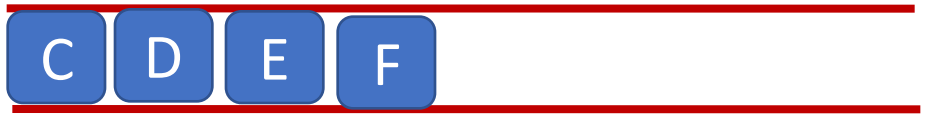


Visited nodes A B C D E

BFS – Traversal – Using Queue



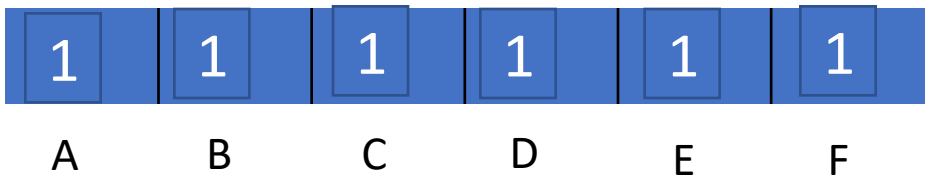
front



Queue

Remove_Q

Visited



Visited nodes A B C D E F

DFS - Algorithm

```
Algorithm DFS (Graph G )
//Implements DFS traversal for given graph
// Input Graph G = (V, E)
//Output Graph G with vertices marked as visited
 mark each vertex in V with 0  as a mark of being "unvisited"
     for each vertex v in V do
          if v is marked with o
               dfs(v)
```

```
dfs(v)
// visits recursively all the unvisited  vertices connected to
    vertex v by a path
For each vertex w in V adjacent to v do
    if w is marked with o
       mark w as visited
       dfs(w)
```

Courtesy: "Introduction to Design and Analysis of Algorithms" By Anany Levitin

BFS - Algorithm

```
Algorithm BFS (Graph G )
//Implements BFS traversal for given graph
// Input Graph G = (V, E)
//Output Graph G with vertices marked as visited
 mark each vertex in V with 0  as a mark of being “unvisited”
     for each vertex v in V do
          if v is marked with 0
               bfs(v)
```

Courtesy: “Introduction to Design and Analysis of Algorithms” By Anany Levitin

BFS - Algorithm

```
bfs(v)
// visits recursively all the unvisited  vertices connected to
    vertex v by a path
While the queue is not empty
   for each vertex w in V adjacent to front vertex do
      if w is marked with 0
         mark w as visited
         add w to queue
         remove the front vertex from the queue
```

Courtesy: “Introduction to Design and Analysis of Algorithms” By Anany Levitin

THANK YOU

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