BOSSCODER ACADEMY

IMPORTANT GRAPH ALGORITHMS

Explained in the **simplest way**

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REVANTH MURIGIPUDI

DISCLAIMER

This document will walk you through the most important graph algorithms from the standpoint of learning and cracking **DSA Interviews**

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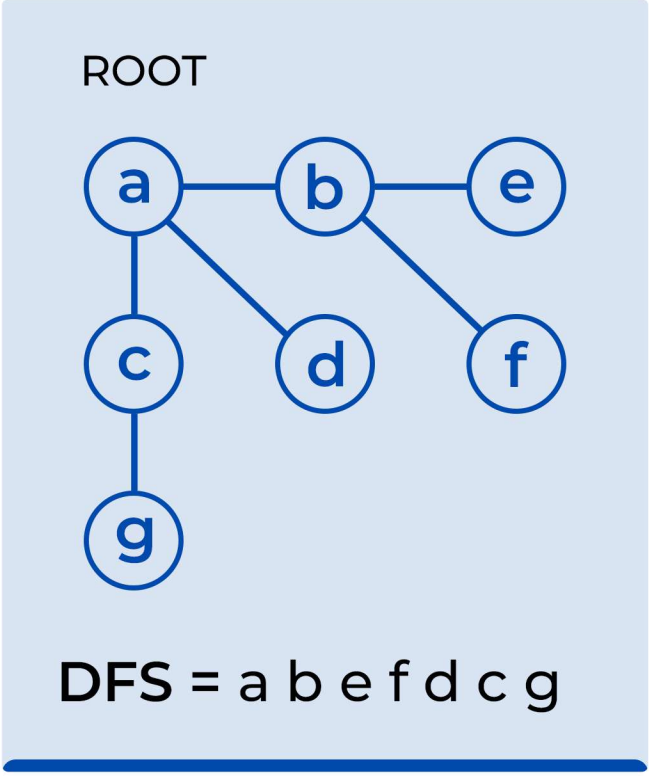
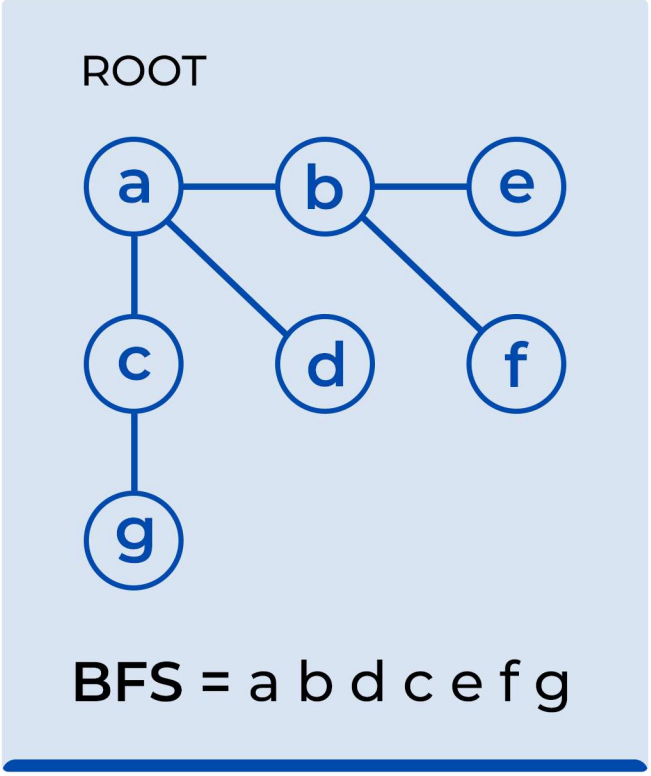
TRAVERSALS IN GRAPH

There are two types of graph traversals :



Depth First search
(DFS)



Breadth First search
(BFS)

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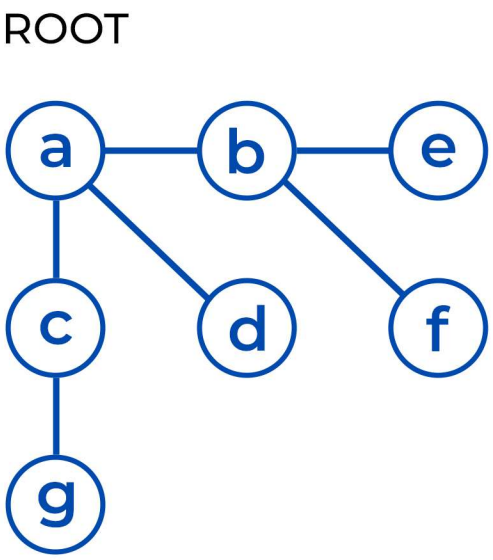
DEPTH FIRST SEARCH (DFS)

Traverse from a node (often termed as root node), and keep going as deep as possible on a branch until you hit the dead end, and then traverse back on the branch and again go deep exploring the other paths



DFS = a b e f d c g

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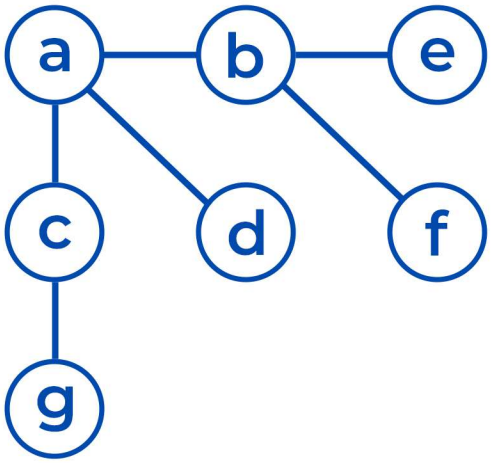
BREADTH FIRST SEARCH (BFS)

Traverses from a node (also called root node), and explores the neighboring nodes first, and then selects one neighbor node and again explores its neighbor nodes until it hits the dead end

ROOT



BFS = a b d c e f g

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MINIMUM SPANNING TREE (MST)

In an **undirected** and a **connected graph**, a spanning tree is a connected subgraph that doesn't have a cycle

And, if the connected graph has N vertices, the spanning tree has **N-1 edges** (ensures no cycle is formed)

Here, remember that a single graph can have many spanning trees

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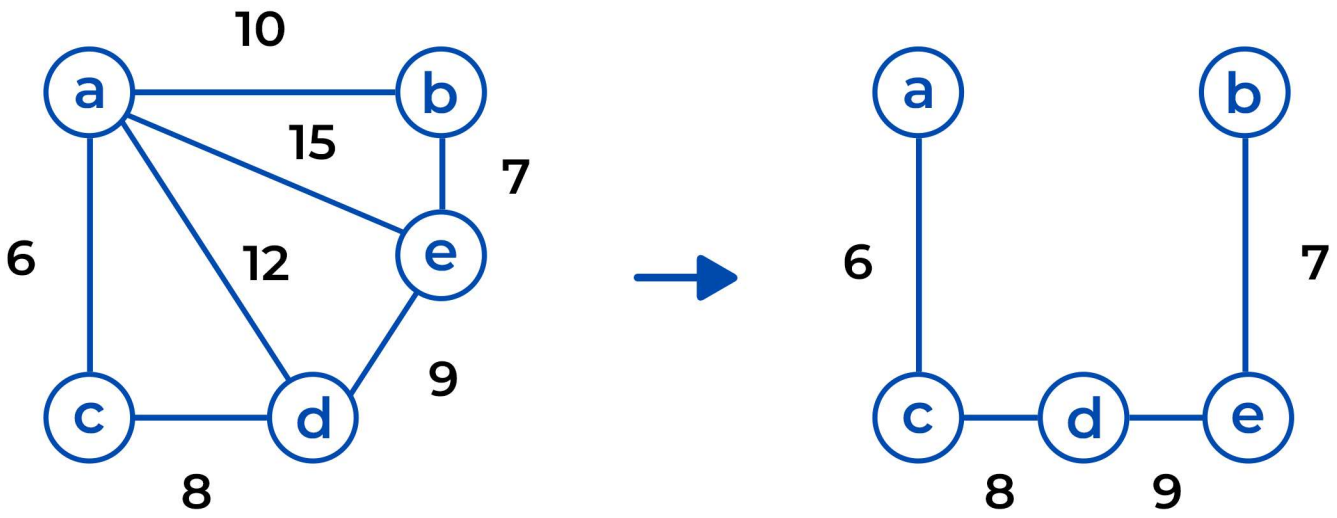
Sum of weights of the edges in a **spanning tree** is called the cost

In a minimum spanning tree for an undirected, weighted & connected graph this cost is the least out of all other spanning trees



Minimum Spanning Tree
(MST)

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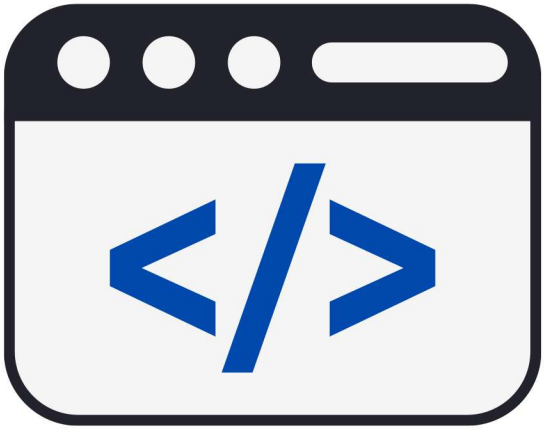
TRAVERSALS IN GRAPH

There are two algorithms to build MST

- Prim's algorithm
- Kruskal's algorithm



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PRIM'S ALGORITHM

This is a **greedy algorithm** which starts with a vertex, & tries to add the minimum edge connected to this vertex out of all the edges, & repeats the same process till the MST is formed

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KRUSKAL'S ALGORITHM

Again a **greedy algorithm** where we start with sorting all the edges first, and then picking the edge with lowest weight and repeating the process

At any point of time, if it forms a cycle, discard this edge and continue till the MST is formed

PS : Remember, Prim's algorithm builds MST by connecting vertices and Kruskal's algorithm builds MST by connecting edges

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PREPARING FOR

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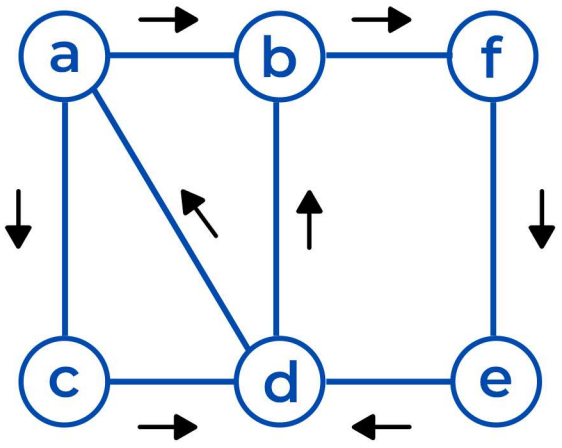
EULERIAN PATH & CIRCUIT

Eulerian Path - A path that visits all the edges in a graph exactly one time!



EP = a c d a b f e d b

Euler Path Diagram

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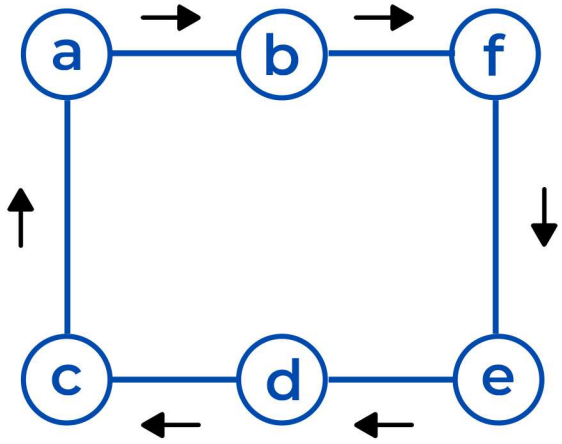
Eulerian Circuit - A Euler path that visits all the edges in a graph exactly one time, but has the same starting and ending vertex!



EC = a b f e d c a

Euler Circuit Diagram

You can say if a graph has :

- **Eulerian Path -** If the graph has 0 or 2 nodes have odd degree & all other nodes have even degree

- **Eulerian Circuit -** If the graph has all vertices with even degree

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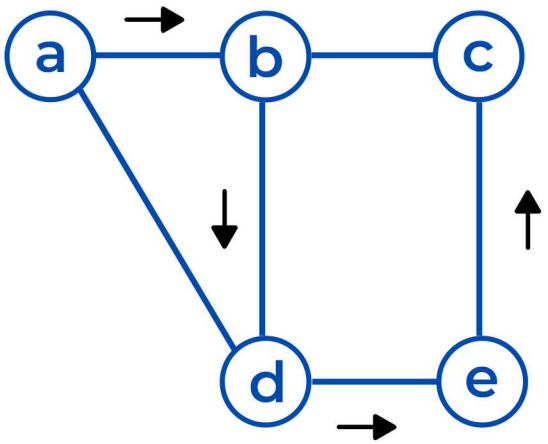
HAMILTONIAN PATH & CIRCUIT

Hamiltonian Path - A path which visits every vertex exactly once in a graph



HP = a b d e c

Hamiltonian Path Diagram

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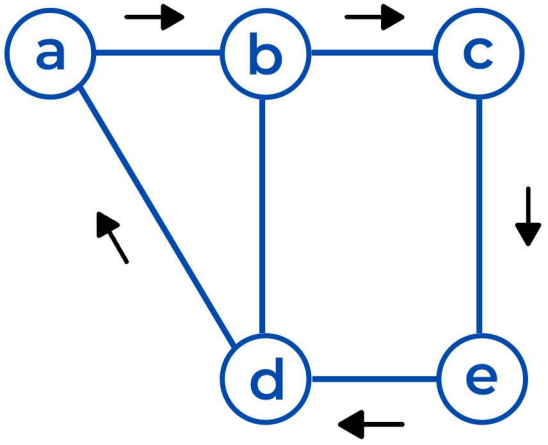
Hamiltonian Circuit - A hamiltonian path that starts with a vertex, and ends at the same vertex



HC = a b c e d a

Hamiltonian Circuit Diagram

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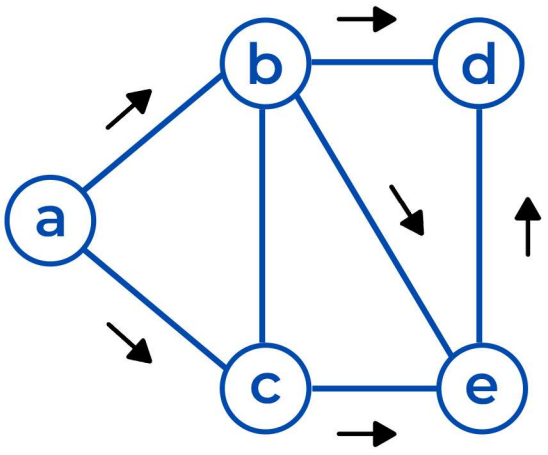
TOPOLOGICAL SORT

Topological sort can only be done on a directed acyclic graph (DAG). It returns an array, basically an ordering of vertices, where, if there is a directed edge from U to V, then U vertex is present before V in the ordering list/array



TS = a b c e d

Topological Sort Diagram

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WIDELY USED SHORTEST PATH GRAPH ALGOS

To find the shortest path in a graph, you have multiple algorithms :

- **BFS algorithm** - Use BFS if the graph is undirected with unit weights
- **Djikstra's Algorithm** - If graph is directed and has no negative weight cycles then You can use Djikstra Algorithm
- **Bellman Ford Algorithm** - If the graph has negative weight cycles, then use Bellman Ford Algorithm

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I got placed at ByteDance Singapore and I am very thankful to **Bosscoder Academy**

Irshad
ByteDance

Bosscoder gives you everything starting from **DSA, LLD** and **HLD** followed **CS Fundamentals**

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