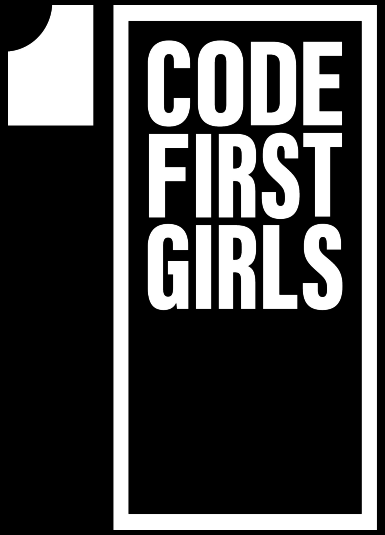
GRAPH DATA STRUCTURE

LESSON 19



NANODEGREE → ENGINEERING MODULE

AGENDA

01 Introduction to Graph Data Structure

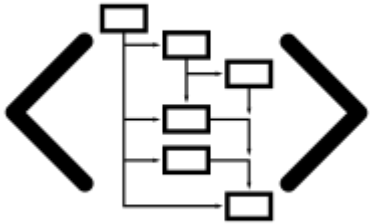
02 Types of Graphs

03 Graph implementation

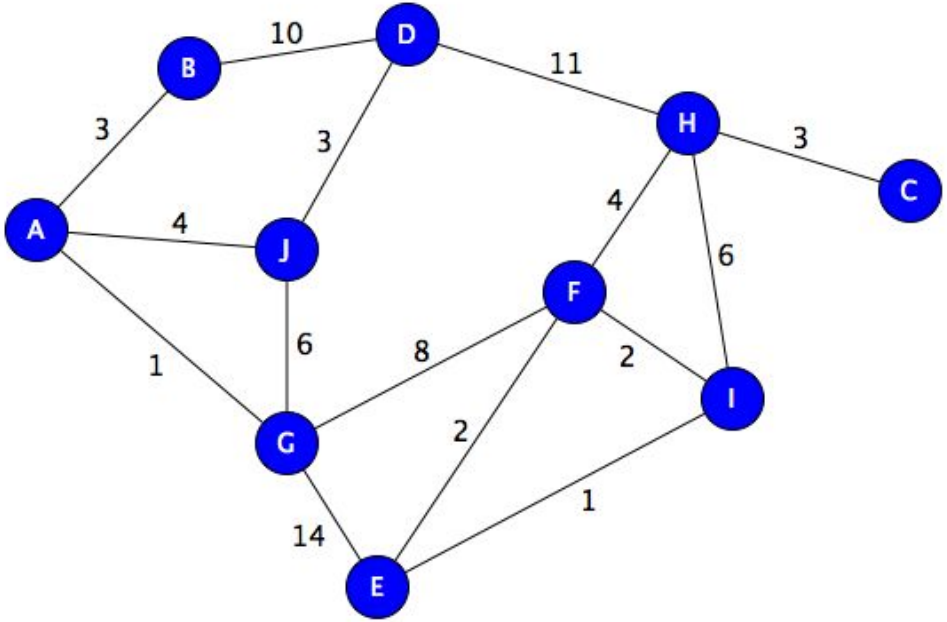
04 Practice and Exercises

GRAPH DATA STRUCTURE

INTRODUCTION

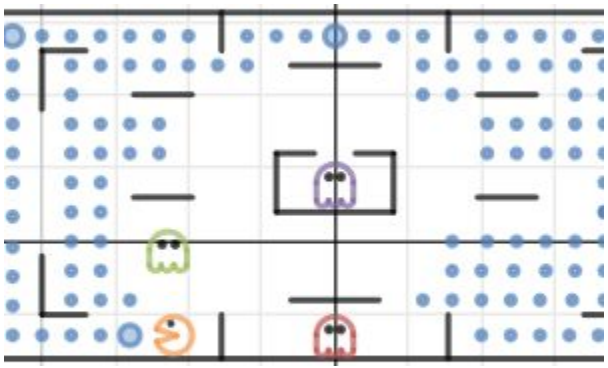


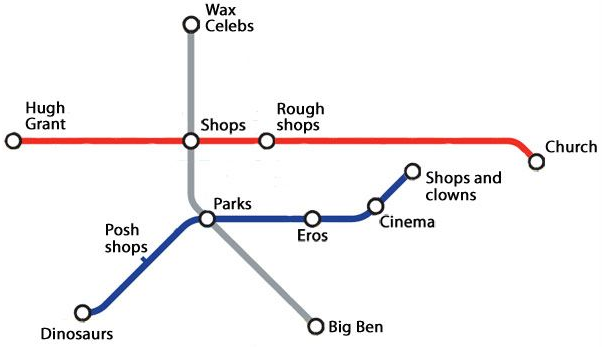
GRAPH STRUCTURE

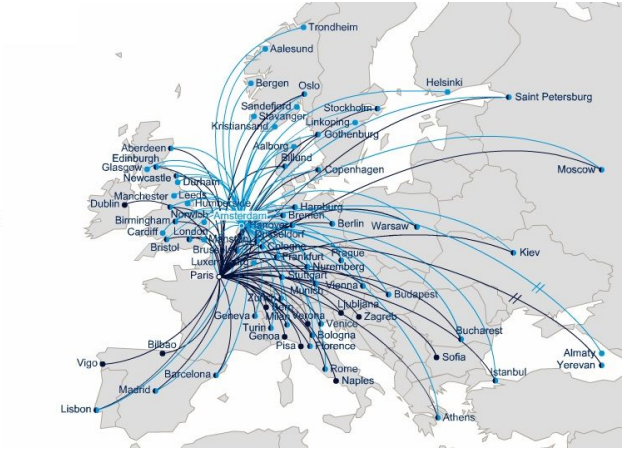


- A **GRAPH** consists of a finite set of vertices or nodes and a set of edges connecting these vertices.
- Two vertices are said to be adjacent if they are connected to each other by the same edge..

GRAPH LIFE EXAMPLES







- Social media
- Games
- Travel maps
- Many more!

GLOSSARY

- **Order:** The number of vertices in the graph
- **Size:** The number of edges in the graph
- **Vertex degree:** The number of edges that are incident to a vertex
- **Isolated vertex:** A vertex that is not connected to any other vertices in the graph
- **Self-loop**: An edge from a vertex to itself
- **Directed graph:** A graph where all the edges have a direction indicating what is the start vertex and what is the end vertex
- **Undirected graph:** A graph with edges that have no direction
- **Weighted graph:** Edges of the graph has weights
- **Unweighted graph:** Edges of the graph has no weights
- **Graph cycle:** a cycle occurs when three or more vertices in the graph are connected so as to form a closed loop
- **Acyclic graph:** a graph that has no cycles
- **Cyclic graph:** a graph that has at least one cycle
- **Connected graph:** graph is connected if for every pair of vertices in the graph there is a path of one or more edges connecting the given vertices.

- These are key definitions that we need to know in relation to GRAPHs

BREADTH-FIRST SEARCH

BFS

Starts at a particular vertex and explore all of its neighbours at the present depth before moving on to the vertices in the next level.

EXAMPLES

- Used to determine the shortest paths and minimum spanning trees.
- Used to search on social networks.

DEPTH-FIRST SEARCH

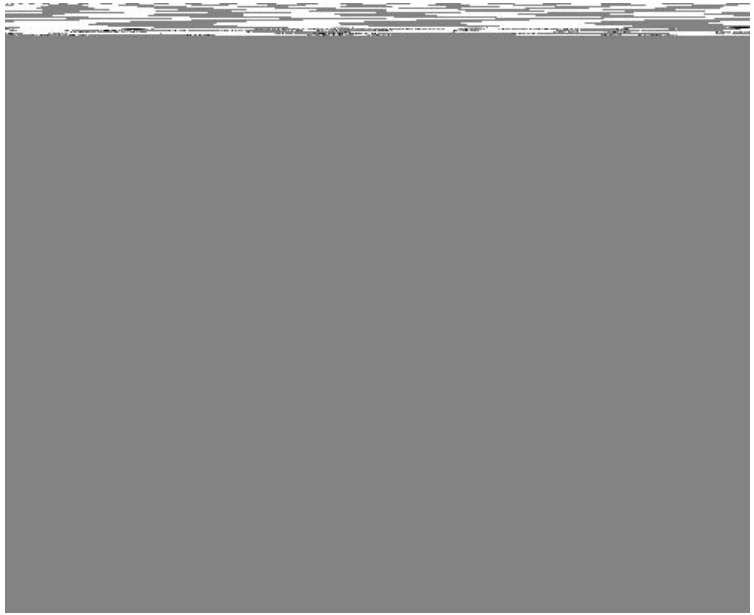
DFS

Starts from a particular vertex and explore as far as possible along each branch before retracing back (backtracking).

EXAMPLES

- Used to find a path between two vertices.
- Used to detect cycles in a graph.
- Used in topological sorting.
- Used to solve puzzles having only one solution (e.g., mazes)

SHORTEST PATH



SHORTEST PATH

The shortest path from one vertex to another vertex is a path in the graph such that the sum of the weights of the edges that should be travelled is minimum. (Dijkstra's shortest path algorithm, Bellman–Ford algorithm)

EXAMPLES

- Used to find directions to travel from one location to another in mapping software like Google maps or Apple maps.
- Used in networking to solve the min-delay path problem.

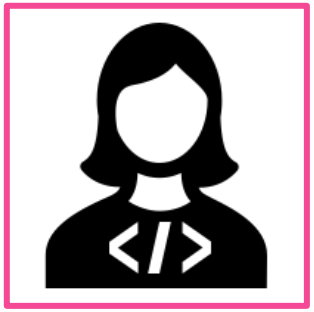
CYCLE DETECTION

CYCLE

Path in a graph where the first and last vertices are the same. If we start from one vertex, travel along a path and end up at the starting vertex, then this path is a cycle.

EXAMPLES

- Used in distributed message-based algorithms.
- Used to detect deadlocks in concurrent systems.



DEMO & EXERCISES

1. Implementing GRAPHS
2. EXERCISES & PRACTICE

THANK YOU!