SPARK GRAPH ANALYSIS

2024

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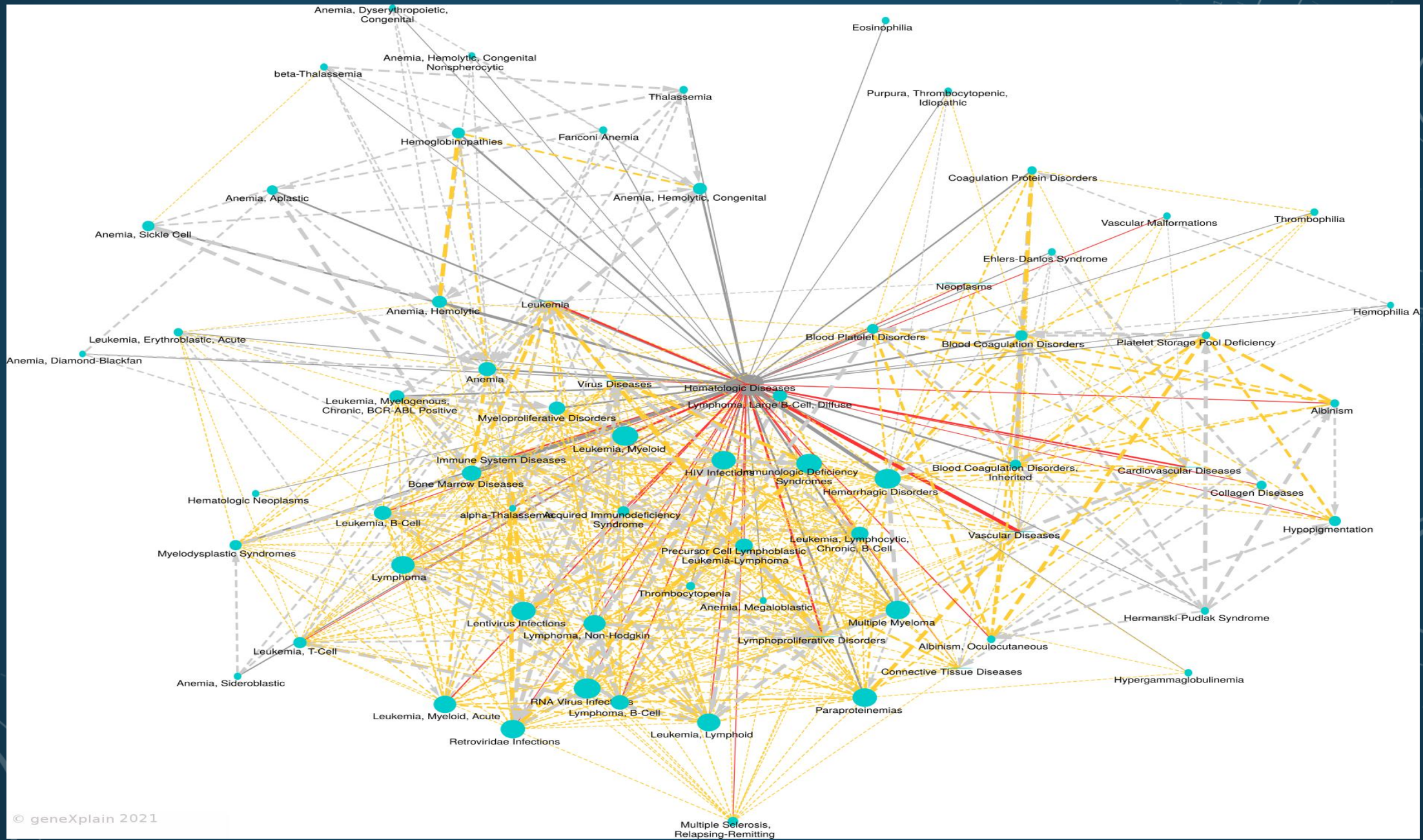
LEARNING OBJECTIVES

- Graph Analysis
- Apache Spark GraphFrames
- Lab practice

GRAPH ANALYSIS – INTRODUCTION



GRAPH ANALYSIS

Definition: *A graph is a non-linear data structure consisting of nodes (also called vertices) and edges that connect them. Think of a graph as a network of interconnected objects, where each object is a node, and the connections between them are edges.*

Types of Graphs:

- Undirected Graph: A graph where edges do not have direction. For example, a friendship network where two people are friends with each other.
- Directed Graph: A graph where edges have direction. For example, a social media network where one person follows another.
- Weighted Graph: A graph where edges have weights or values associated with them. For example, a road network where edges represent distances between cities.
- Unweighted Graph: A graph where edges do not have weights or values associated with them. For example, a simple friendship network.

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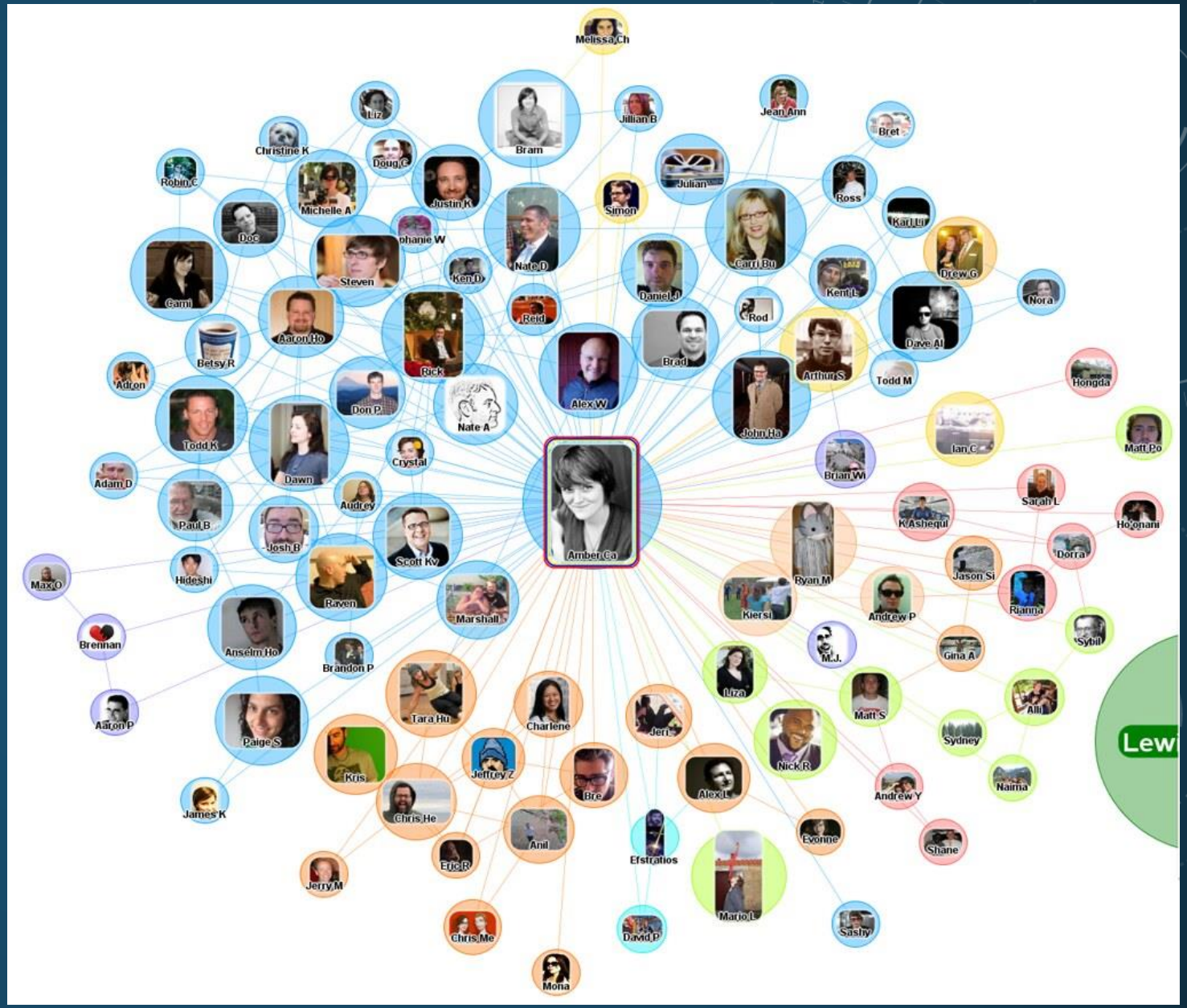
Undirected Graph Example

- Friendship Network



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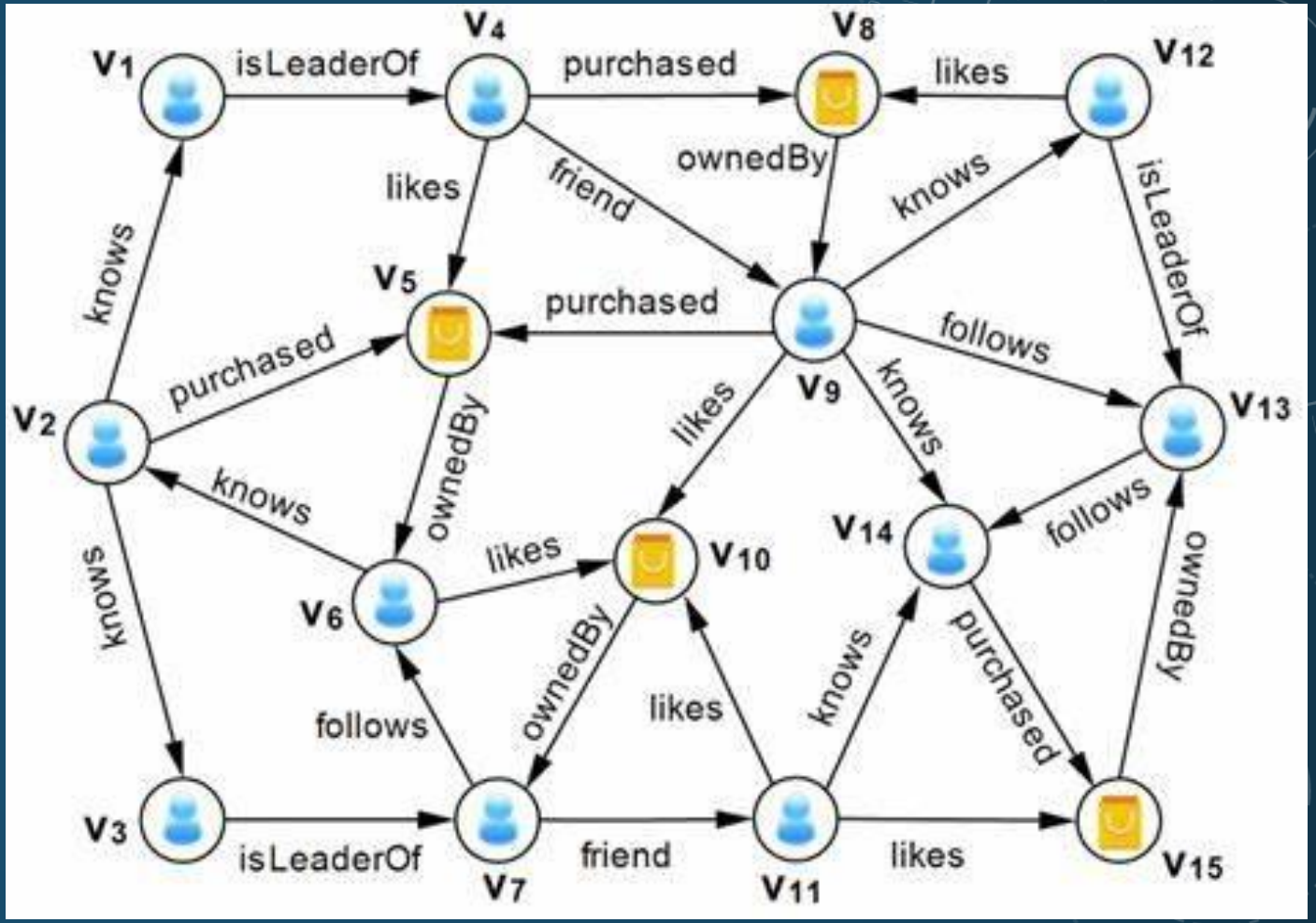
Directed Graph Example

- Social Shopping Network



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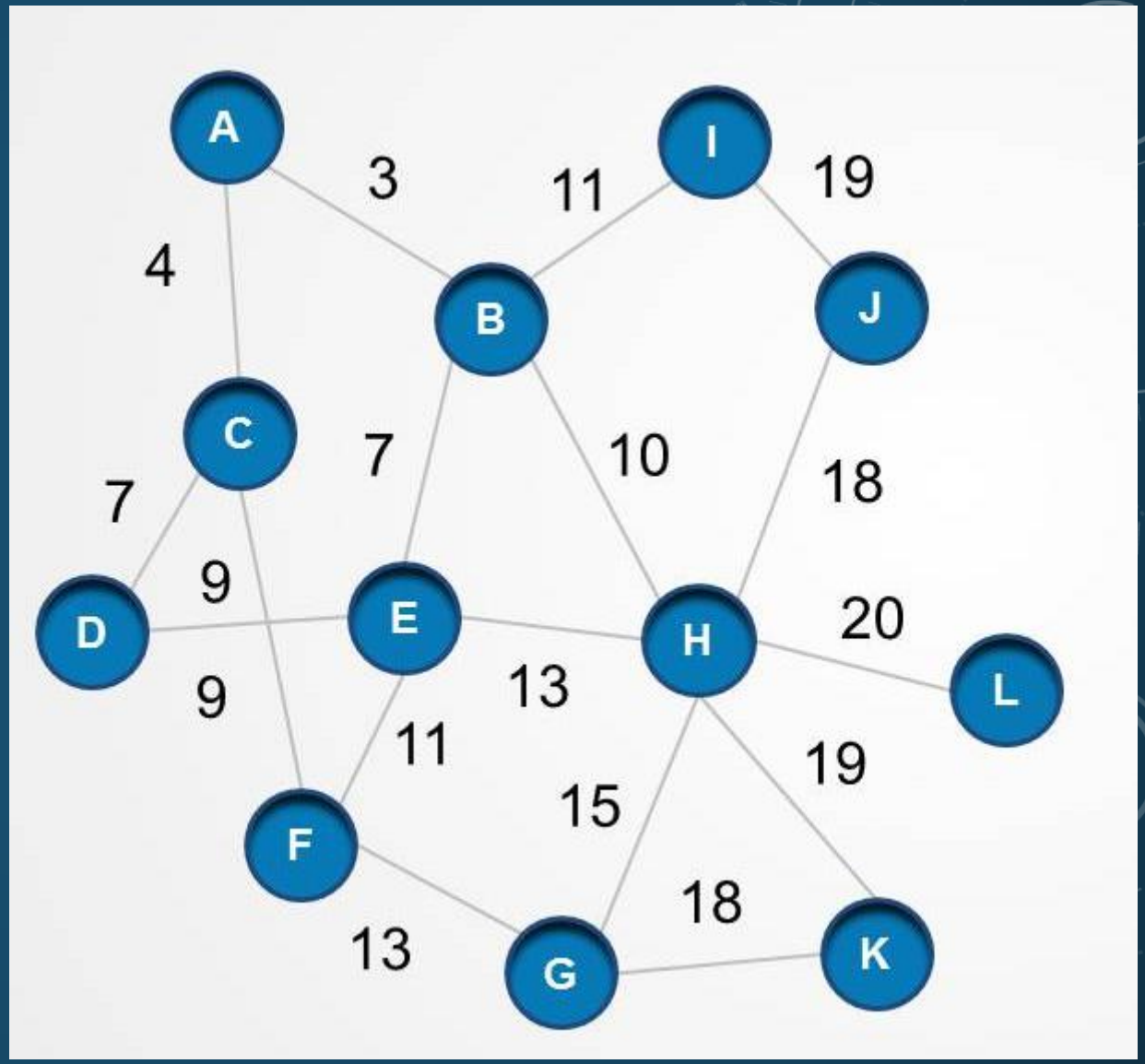
Directed Graph Example

- Road Network



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Graph Analytics Concepts

- Node Degree: The number of edges connected to a node.
- Edge Weight: The value or weight associated with an edge.
- Shortest Path: The minimum number of edges required to travel between two nodes.
- Clustering Coefficient: A measure of how closely connected a node is to its neighbours.
- Centrality Measures: Measures of a node's importance or influence in the graph, such as PageRank or Betweenness Centrality.

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Graph Analytics Techniques

- Graph Search: Finding a specific node or path in a graph.
- Graph traversal to explore all nodes connected to a certain node.
- Finding shortest paths between nodes.
- Detecting communities or clusters of nodes that are densely connected.
- Identifying important nodes using centrality measures (like PageRank).
- Graph Clustering: Grouping similar nodes together based on their connections.
- Graph Embeddings: Representing nodes as vectors in a high-dimensional space to capture their relationships.

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Real-World Applications

- Social Network Analysis: Analyzing relationships between people in social media networks.
- Recommendation Systems: Recommending products or services based on user behaviour and preferences.
- Traffic Optimization: Optimizing traffic flow in transportation networks.
- Network Security: Identifying vulnerabilities in computer networks.
- Biological Network Analysis: Analyzing relationships between genes, proteins, and other biological molecules.

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Graph Analysis using Apache Spark

- Apache Spark GraphX, **GraphFrames**: A graph processing engine built on top of Apache Spark.

Feature	GraphX	GraphFrames
Underlying Structure	RDD-based	DataFrame-based
API Level	Lower-level	Higher-level, more user-friendly
Performance	Optimized for graph-parallel computations	Leverages DataFrame optimizations
Complex Queries	More manual; requires RDD manipulations	Supports SQL-like queries
Ease of Use	More complex for beginners	Easier for users familiar with DataFrames
Graph Algorithms	Basic algorithms provided	Rich set of algorithms with easier access

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Lab practice