

Foundations of Modern Query Languages for Graph Databases

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Abstract

We survey foundational features underlying modern graph query languages. We first discuss two popular graph data models: edge-labelled graphs, where nodes are connected by directed, labelled edges, and property graphs, where nodes and edges can further have attributes. Next we discuss the two most fundamental graph querying functionalities: graph patterns and navigational expressions. We start with graph patterns, in which a graph-structured query is matched against the data. Thereafter, we discuss navigational expressions, in which patterns can be matched recursively against the graph to navigate paths of arbitrary length; we give an overview of what kinds of expressions have been proposed and how they can be combined with graph patterns. We also discuss several semantics under which queries using the previous features can be evaluated, what effects the selection of features and semantics has on complexity, and offer examples of such features in three modern languages that are used to query graphs: SPARQL, Cypher, and Gremlin. We conclude by discussing the importance of formalisation for graph query languages; a summary of what is known about SPARQL, Cypher, and Gremlin in terms of expressivity and complexity; and an outline of possible future directions for the area..