W6. Lecture Notes — By Junyi

Summary

Graph inference algorithms fall into two broad categories

- Traditional Graph Algorithms
  - Path finding, centrality, community detection
- Ontology-based algorithms
  - Taxonomic reasoning, Rule-based reasoning

▼ knowledge graph retrieval
  ▼ Query languages
    ▼ SPARQL
    ▼ Cypher
▼ knowledge graph inference
  ▼ draw implicit conclusions E.g., conclude new connections
  ▼ algorithms
    ▼ graph-based
      ▼ path finding
        ▼ shortest path
        ▼ single source shortest path
        ▼ minimum spanning tree
      ▼ centrality detection
        ▼ function
          - understanding the importance of a node - most important nodes, bridges in a network
        ▼ types

- degree centrality
- betweenness centrality
- closeness centrality
- page rank

- community detection
  - algorithms
    - standard graph algorithms
      - connected components
      - strongly connected components
    - bottom up algorithms
      - label propagation
        - assign each node to be a different community
        - examine all nodes in a fixed order → update the community of a node that is shred by most of its neighbors, break ties in a random order
        - terminate when each node is in a community shared by most of its neighbors
      - unfolding
        - phase 1
          - Assign each node into a separate community
          - Examine each node and its neighbors to test if there will be an overall gain in modularity by placing it in the same community as a neighbor
        - phase 2
          - Create a new graph in which each node represents a community from Phase I
          - If there are edges between nodes in a community, represent it as a self-loop
        - repeat

▼ ontology-based

▼ KG features

- Associates classes with nodes
- Defines semantic properties of relationships
- Two major categories of inference

▼ Class-based Inference or Taxonomic Reasoning

▼ Application conditions

▼ applicable when it is useful to organize knowledge into classes

▼ both property graph and RDF data models support classes

▼ class

▼ hierarchy

▼ disjoint

▼ definition

▼ necessary properties

▼ have instance-of in the body of the rule

▼ sufficient properties

▼ have instance-of in the head of the rule

▼ value restriction

▼ domian

▼ range

▼ cardinality

▼ inheritance

▼ Rule-based inference

▼ Boundary between taxonomic inference and rule-based inference is not sharp

- It is generally a matter of the implementation approach

- Taxonomic inferences can be usually implemented using rules

▼ Approaches

▼ bottom up / chase

▼ top-down

用这个做树状图！

Taxonomic Inference

- Given two classes A and B, whether A is a subclass of B?
- Given a class A and an instance I, whether I is an instance of I?
- Given a ground relation atom determine whether it is true or false?
- Given a relation atom, determine values which values make it true?