GraphRAG and Knowledge Integration

Week 8: From Vector Search to Knowledge Graphs

PhD Course in Agentic Artificial Intelligence

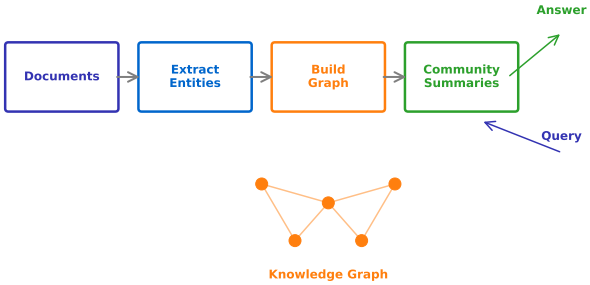
Learning Objectives

Bloom's Taxonomy Levels

- **Remember**: Define knowledge graphs, entities (objects), relations (links), communities (clusters)
- **Understand**: Explain how GraphRAG enhances retrieval with structure
- **Apply**: Build a knowledge graph from unstructured text
- **Analyze**: Compare vector-only vs graph-enhanced retrieval
- **Evaluate**: Assess when GraphRAG provides value over standard RAG
- **Create**: Design a hybrid retrieval system for a domain

By end of lecture, you will understand structured knowledge integration in agents.

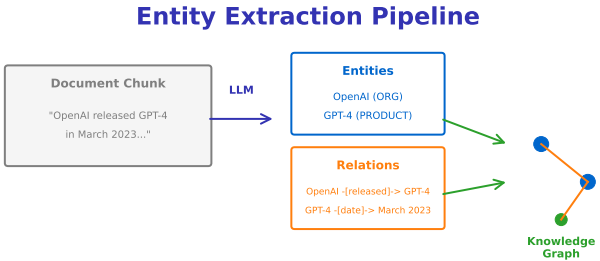
GraphRAG: Knowledge Graph + RAG



Grapl

builds structure from documents before retrieval.

Entity and Relationship Extraction



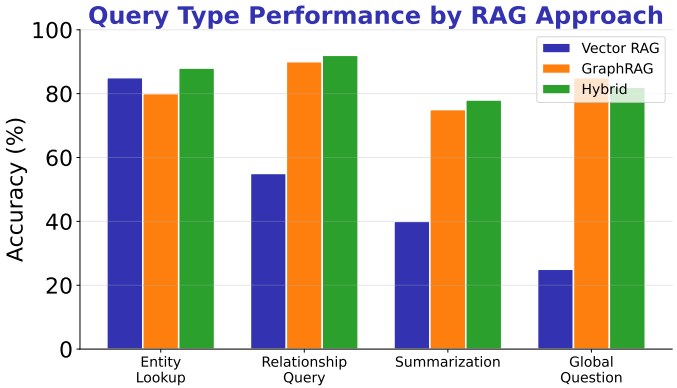
LLMs extract entities and relations to build the knowledge graph.

Hierarchical Community Detection

Leide

algorithm (graph clustering method) clusters entities for hierarchical summarization.

Query Routing by Type



Differ

query types benefit from different retrieval strategies.

Key Papers

This Week

- Edge et al. (2024). "From Local to Global: A GraphRAG Approach." Microsoft Research
- Pan et al. (2024). "Unifying Large Language Models and Knowledge Graphs." arXiv:2306.08302

Supplementary

- Besta et al. (2024). "Graph of Thoughts." arXiv:2308.09687
- Gutierrez et al. (2024). "HippoRAG." arXiv:2405.14831

Focus on the Microsoft GraphRAG paper for implementation details.

Summary

Key Concepts

- **GraphRAG**: Combine knowledge graphs with vector retrieval
- **Entity Extraction**: LLM-based NER (Named Entity Recognition) and relation extraction
- **Communities**: Hierarchical clustering for global queries
- **Hybrid Retrieval**: Route queries to appropriate strategy

Next Week

- Hallucination Prevention and Verification

Graph

= Structure + Vectors for comprehensive retrieval.