Knowledge Graph in Agentic AI

BAI Long (白龙)
Institute of Computing Technology, Chinese Academy of Sciences
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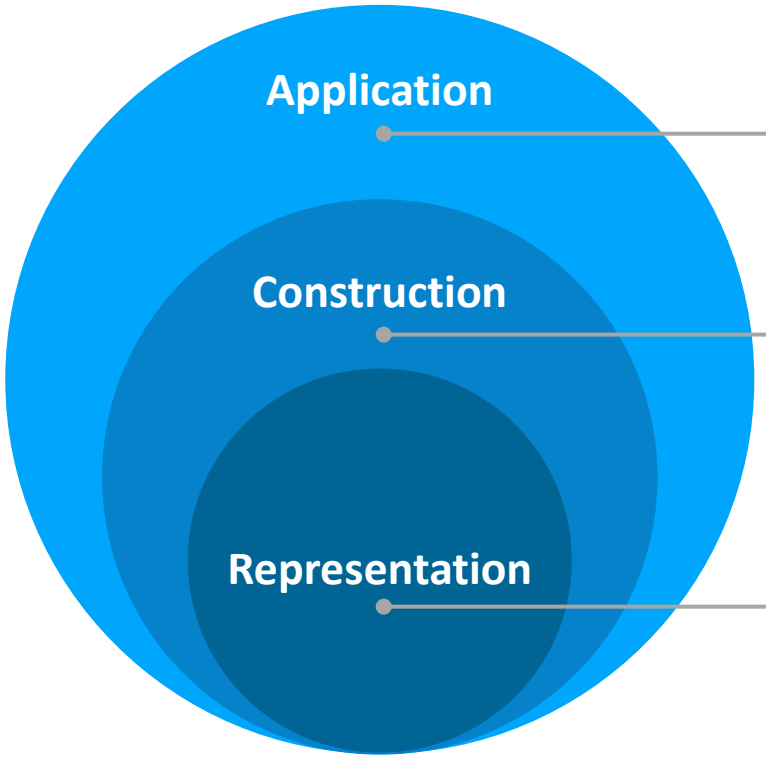
Knowledge Graph Techniques

Three layers of knowledge graph techniques, from core to broader scope



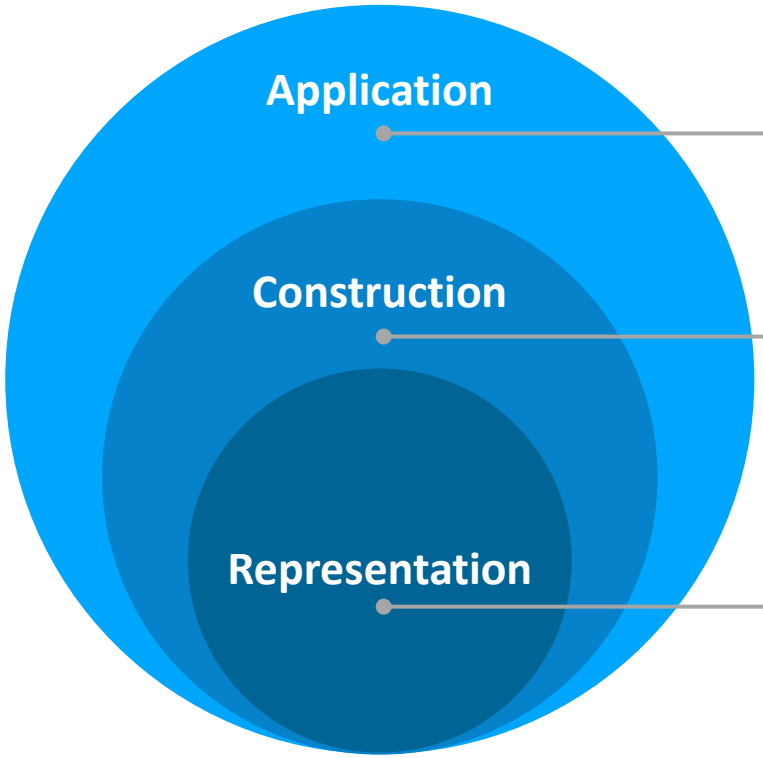
Apply knowledge through reasoning and computation

Construct, integrate, and maintain the knowledge graph

Represent knowledge as entities and relations in graph form

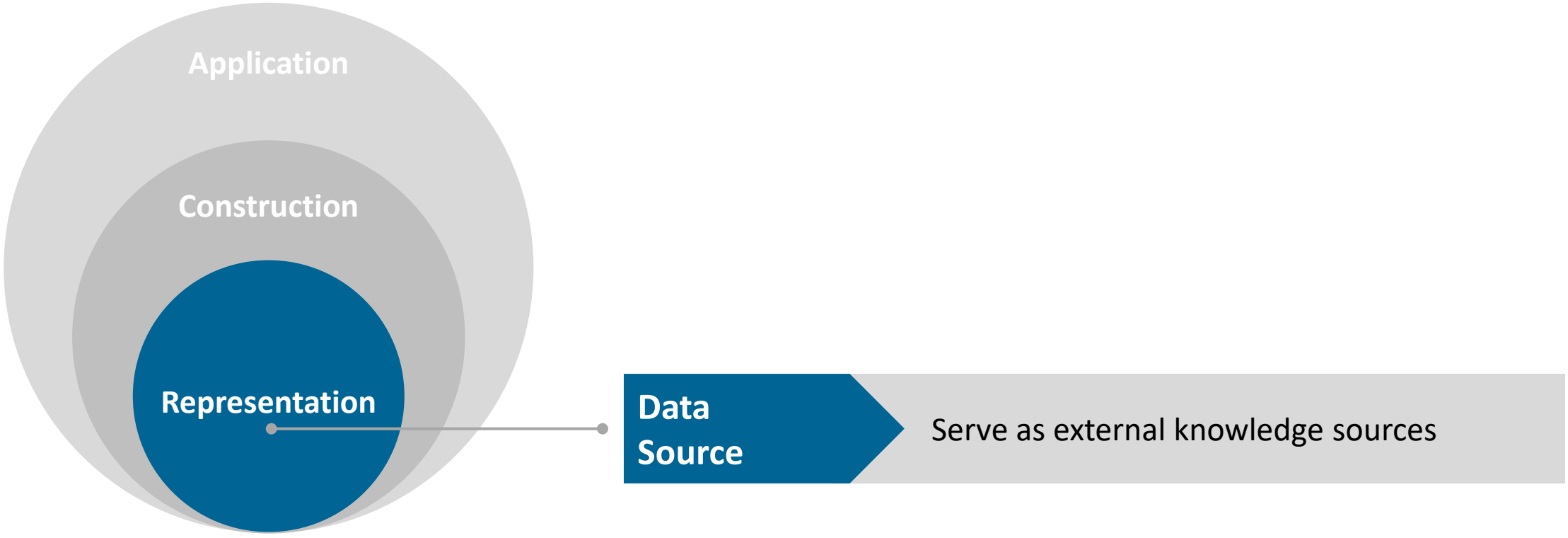
Roles in Agentic AI

In agentic AI, knowledge graph techniques can be utilized in different ways depending on their scopes



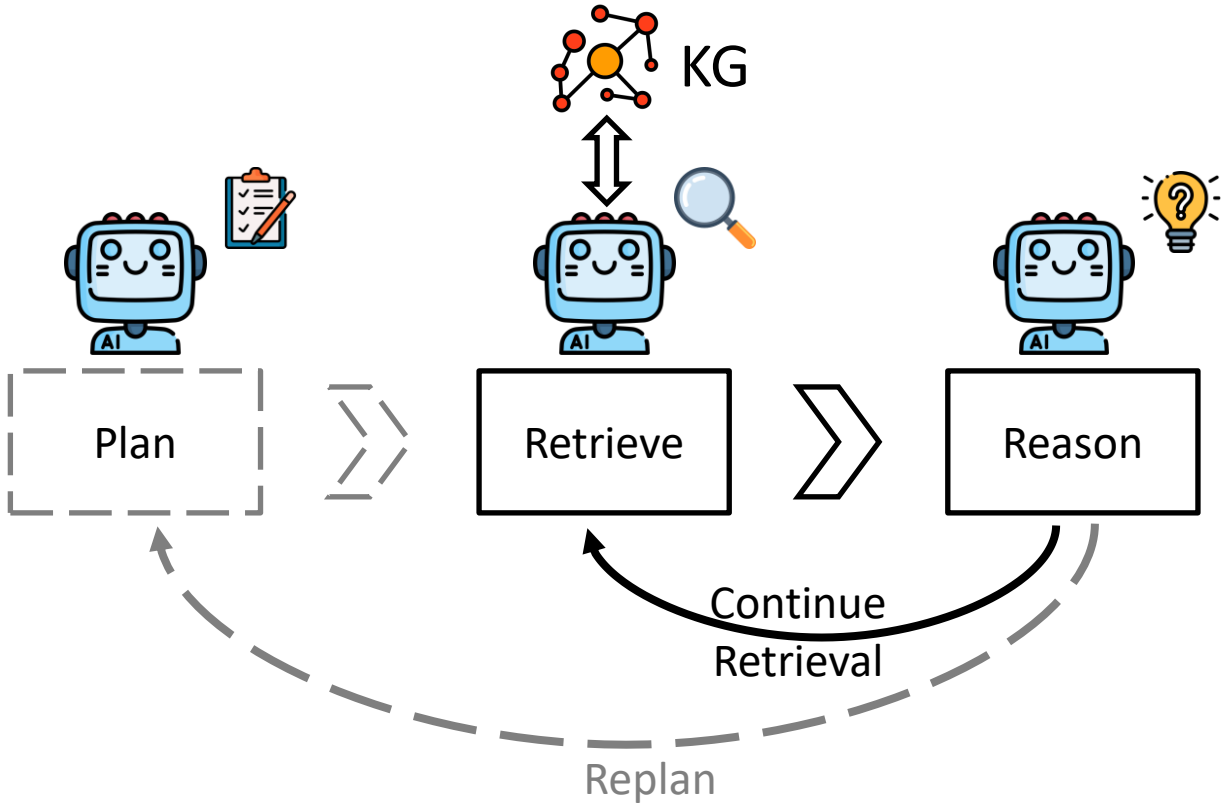
Execution Method	Enable reasoning and computation over knowledge for task execution
Organization Method	Enable structuring and organizing knowledge for use
Data Source	Serve as external knowledge sources

Utilize KG as Data Source

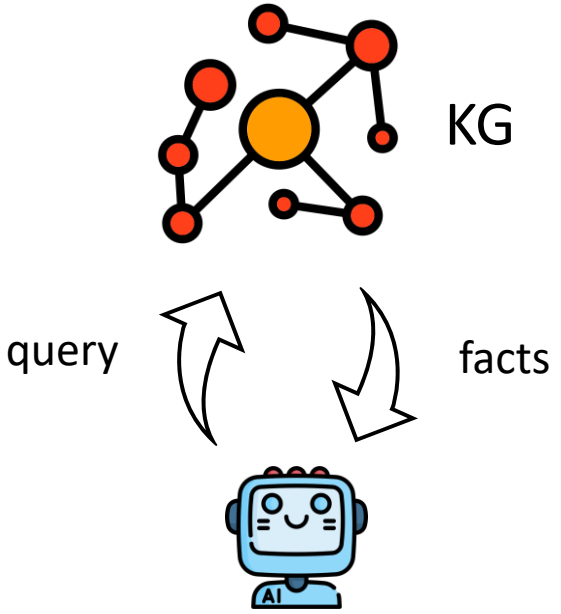


Utilize KG as Data Source

KG as a reliable source for factual grounding

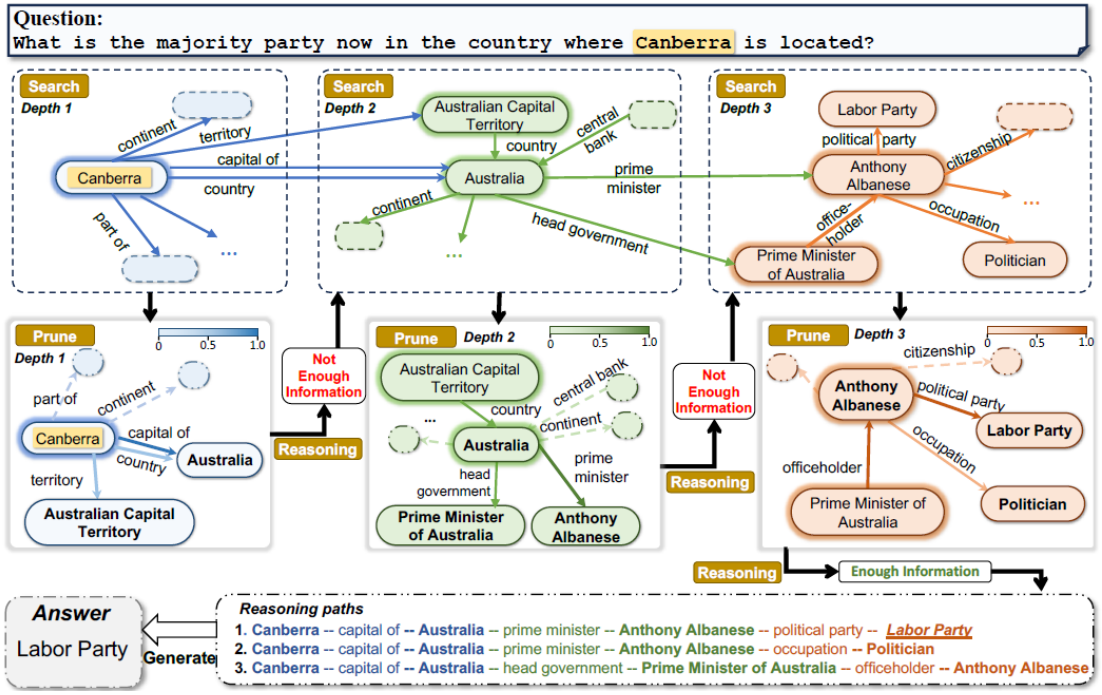


Retrieve: querying facts from KG

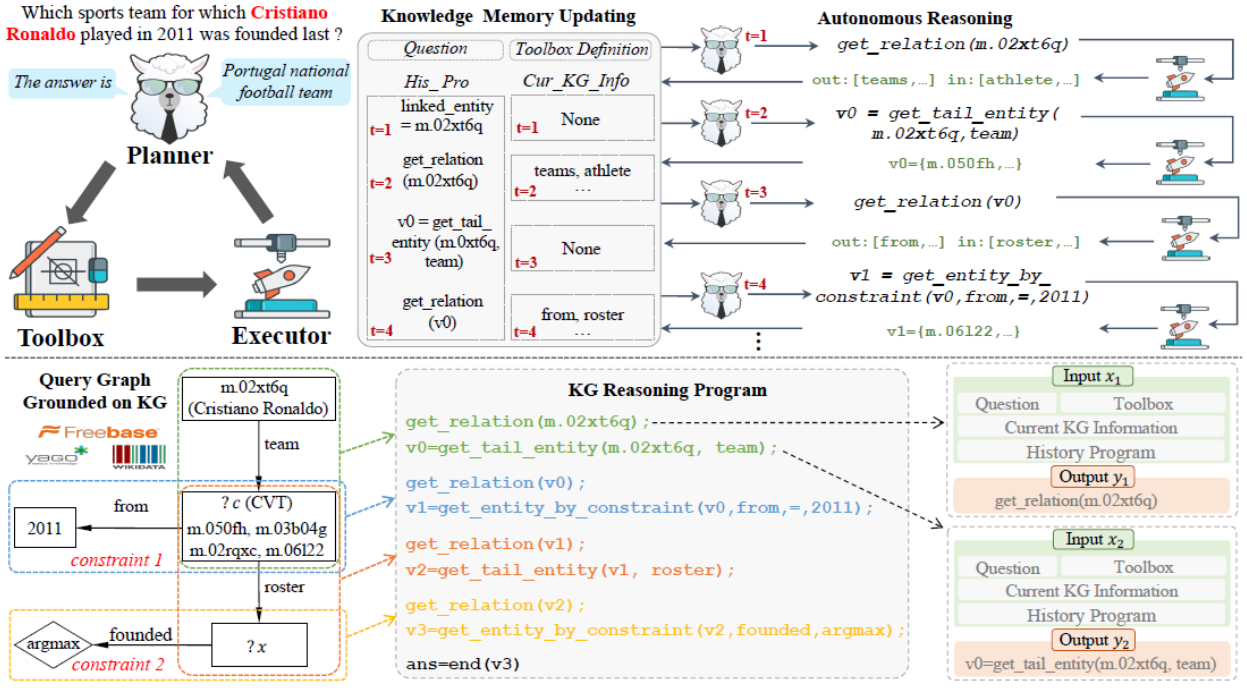


Utilize KG as Data Source

How to improve fact retrieval?



Retrieve one hop facts, filter via LLM

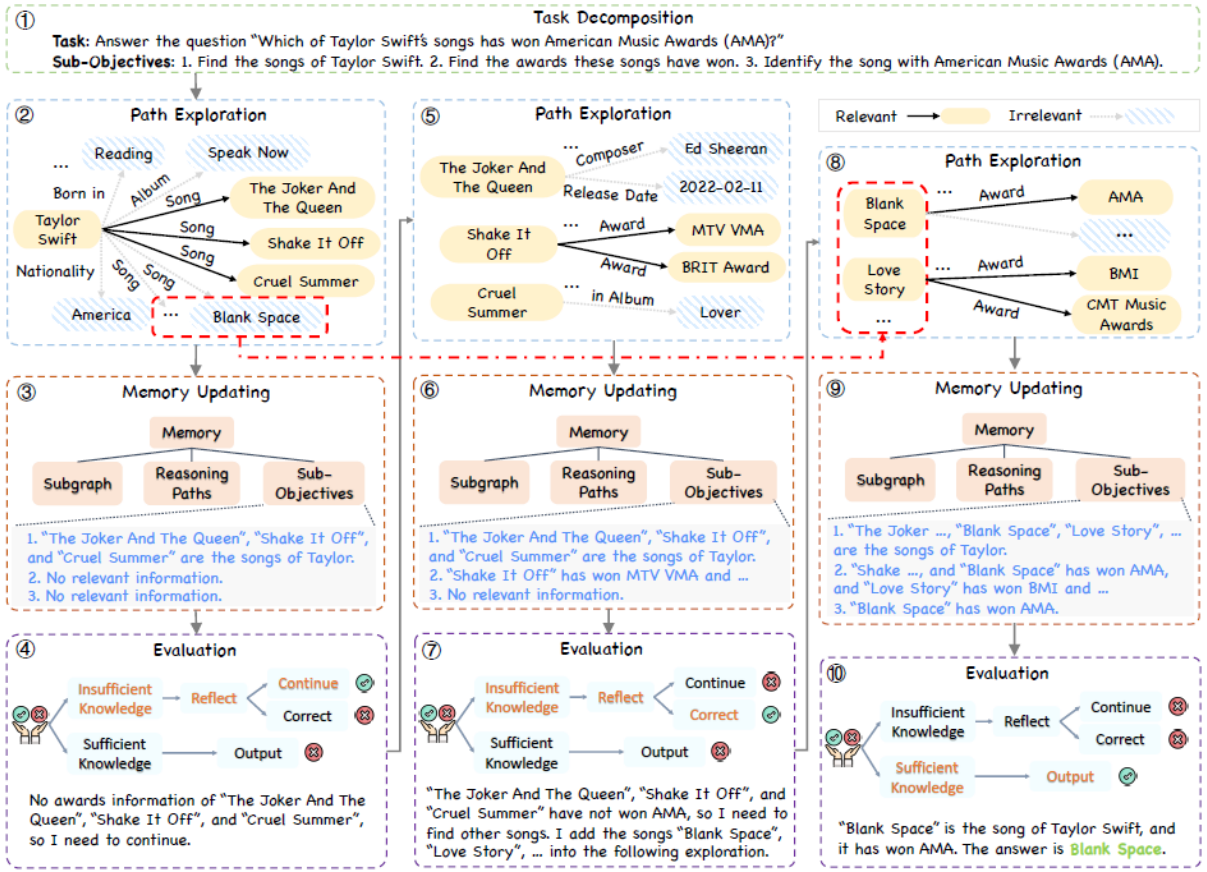


Retrieve via code generation

Think-on-graph: Deep and responsible reasoning of large language model on knowledge graph
KG-Agent: An Efficient Autonomous Agent Framework for Complex Reasoning over Knowledge Graph

Utilize KG as Data Source

How to improve reasoning?



⇦ Introduce planning step to decompose task into sub-tasks

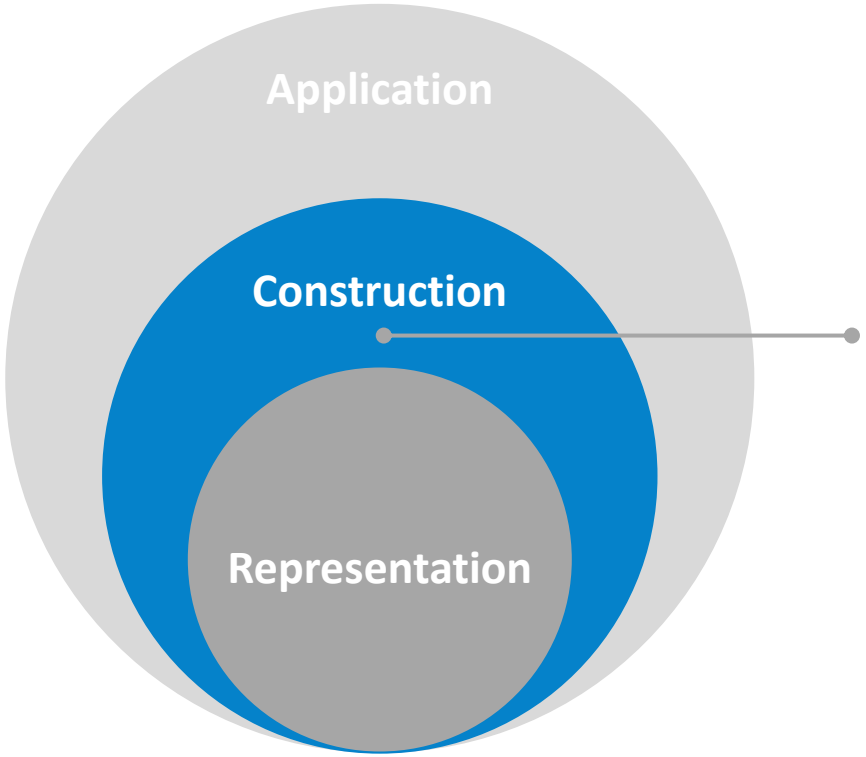
⇦ Self-reflection: Correctness and termination check

Plan-on-Graph: Self-Correcting Adaptive Planning of Large Language Model on Knowledge Graphs

Utilize KG as Data Source

- Current studies can be viewed as a natural extension of knowledge graph question answering (KGQA).
- KG is used in a similar way as document collection in vanilla retrieval-augmented generation (RAG) methods, serving as a retrievable data source.
- Can KG play a more active role in agent?

Utilize KG as Organization Method

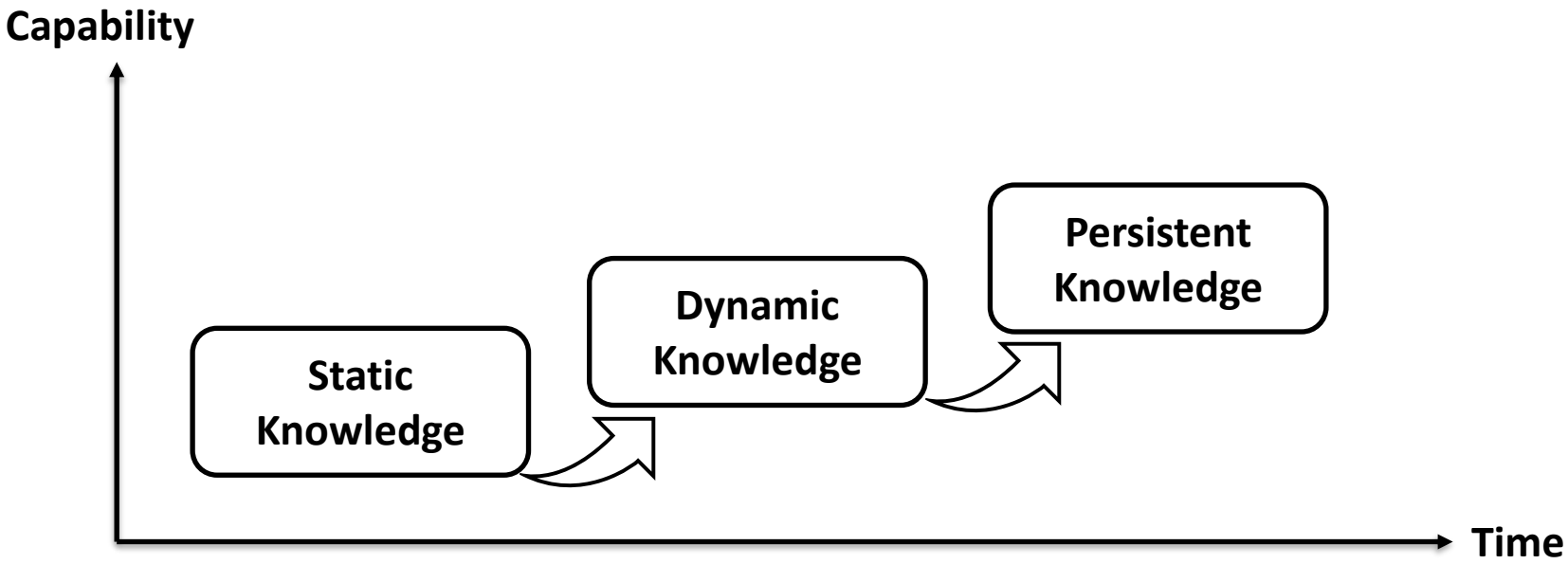


Organization Method

Enable structuring and organizing knowledge for use

Utilize KG as Organization Method

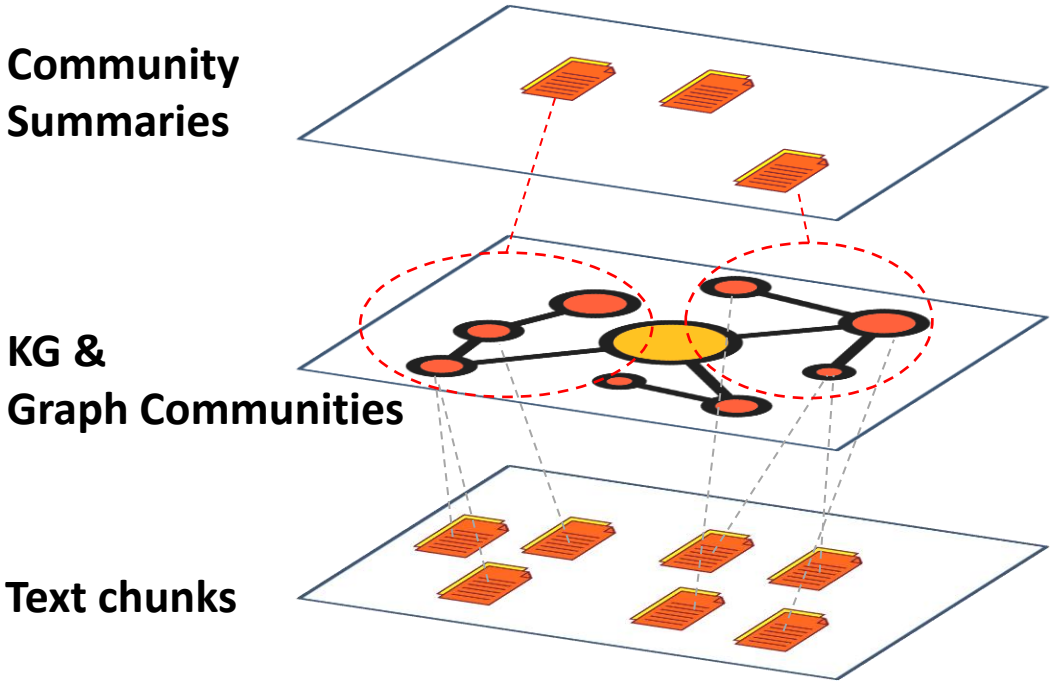
KG as a method to organize knowledge, rather than merely providing data

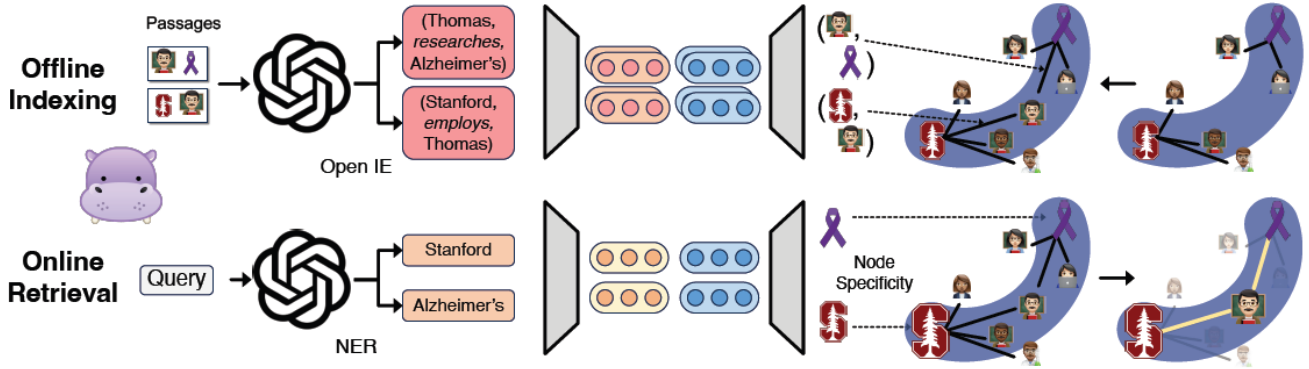


Research focus evolves over time, with increasing capability

Utilize KG as Organization Method

Organize static knowledge, such as document collections





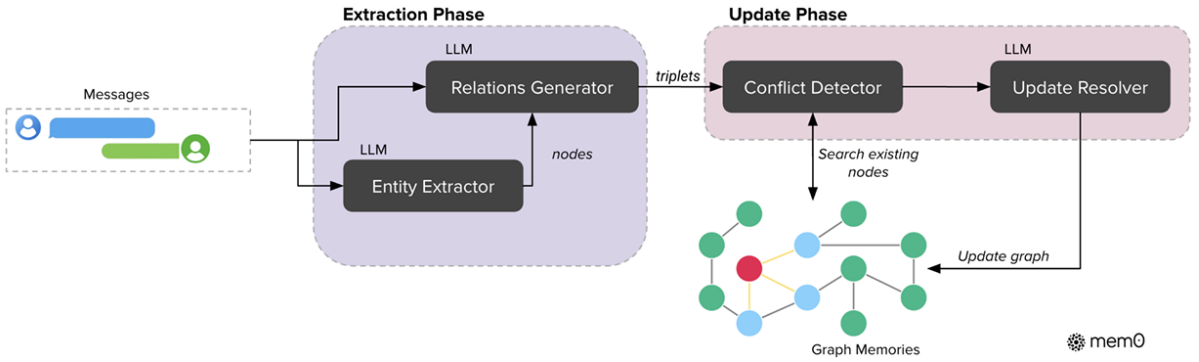
Retrieve subgraph summary
Perform better in summarization tasks

Retrieve path-related documents
Perform better in multi-hop reasoning tasks

From Local to Global: A GraphRAG Approach to Query-Focused Summarization
HippoRAG: Neurobiologically Inspired Long-Term Memory for Large Language Models

Utilize KG as Organization Method

Organize dynamic knowledge that evolves over time

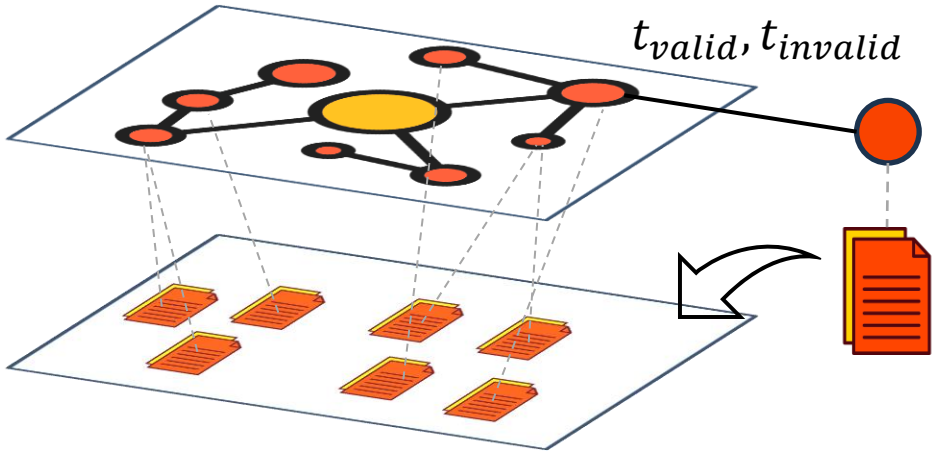


Agent memories are organized via knowledge graph

Conflicts are handled via direct graph modification

Temporal KG

Episodes



Conflict is handled via temporal invalidation

Incrementally updating the graph with new episodes, entities, and facts

Mem0: Building Production-Ready AI Agents with Scalable Long-Term Memory
Zep: A Temporal Knowledge Graph Architecture for Agent Memory

Utilize KG as Organization Method

Organize persistent knowledge that accumulates across tasks

LLM-wiki

Schema Layer

AGENTS.md

Wiki Layer

index.md log.md summaries ...

entity pages concept pages

Raw Sources Layer

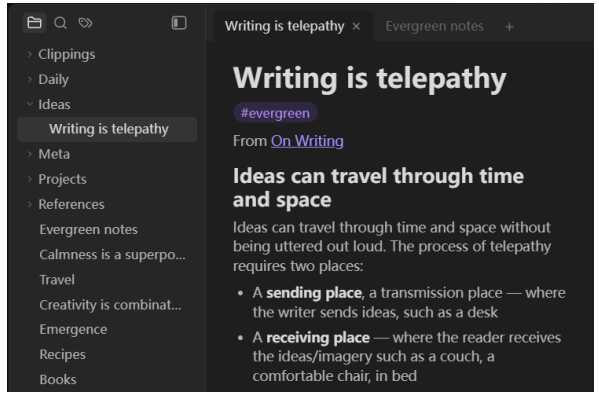
raw/

PDF PNG ...

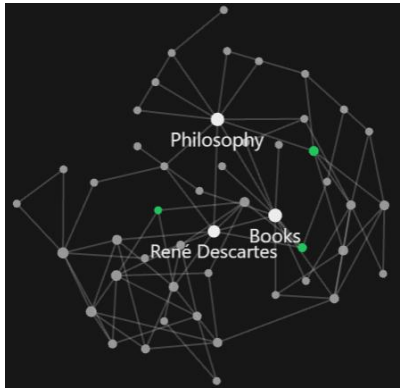
lint health-check the wiki

query ask questions against the wiki, **file back good answers as new pages**

ingest drop a new source into the raw collection and process it



Obsidian frontend

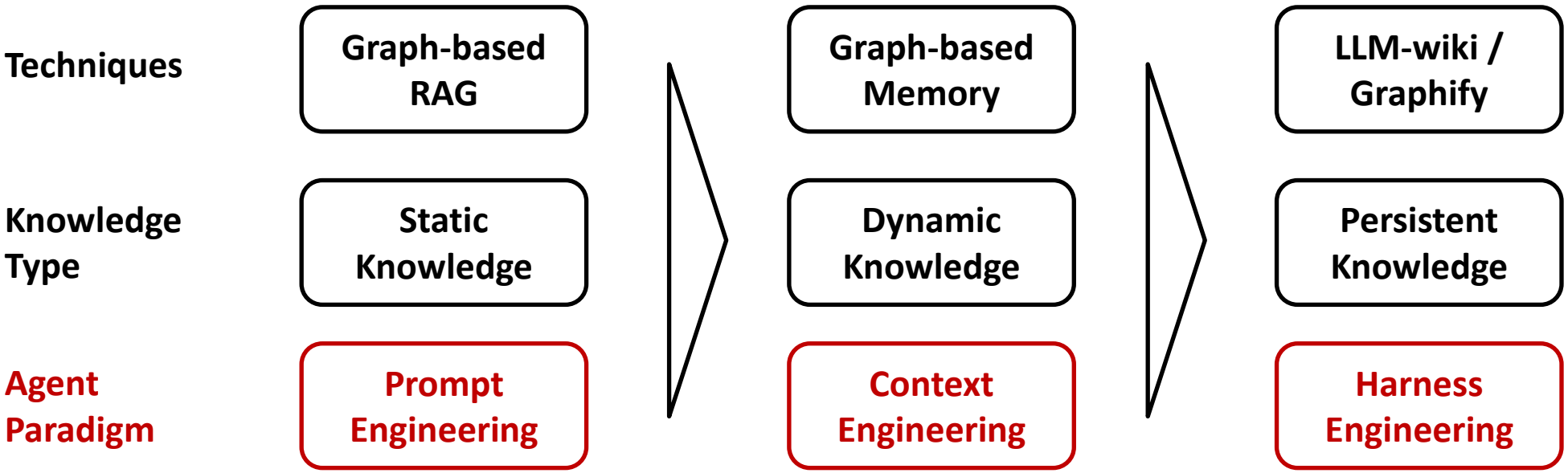


Knowledge Graph frontend

https://gist.github.com/karpathy/442a6bf555914893e9891c11519de94f
https://github.com/safishamsi/graphify

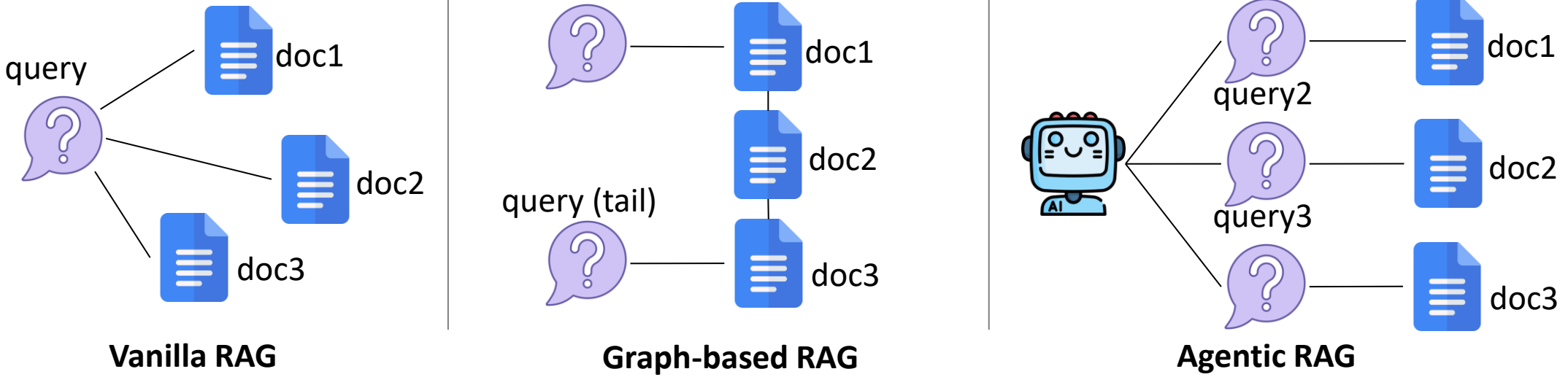
Utilize KG as Organization Method

- The technical breakthroughs in knowledge organization align with the evolve of agent paradigm.



Utilize KG as Organization Method

- Compared to vanilla RAG, one major advantage of Graph-based RAG is the capability of multi-hop reasoning.
  - However, this advantage is diminished by techniques like agentic RAG

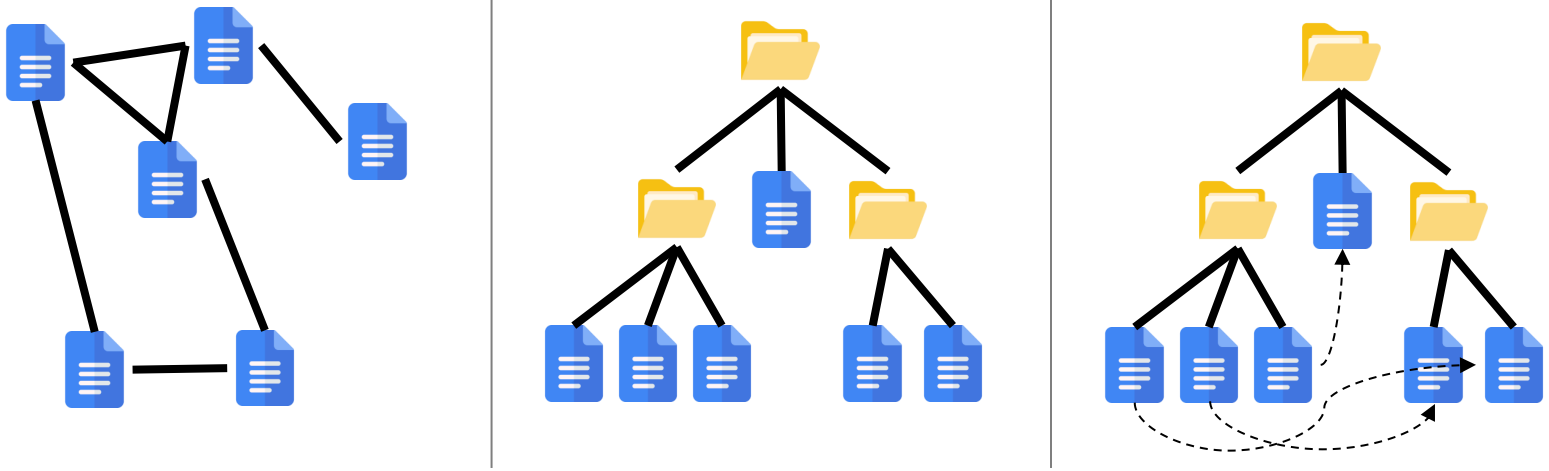


Are there other reasons to organize knowledge in the form of a knowledge graph?

Utilize KG as Organization Method

- LLM-wiki is not in the classical form of knowledge graph

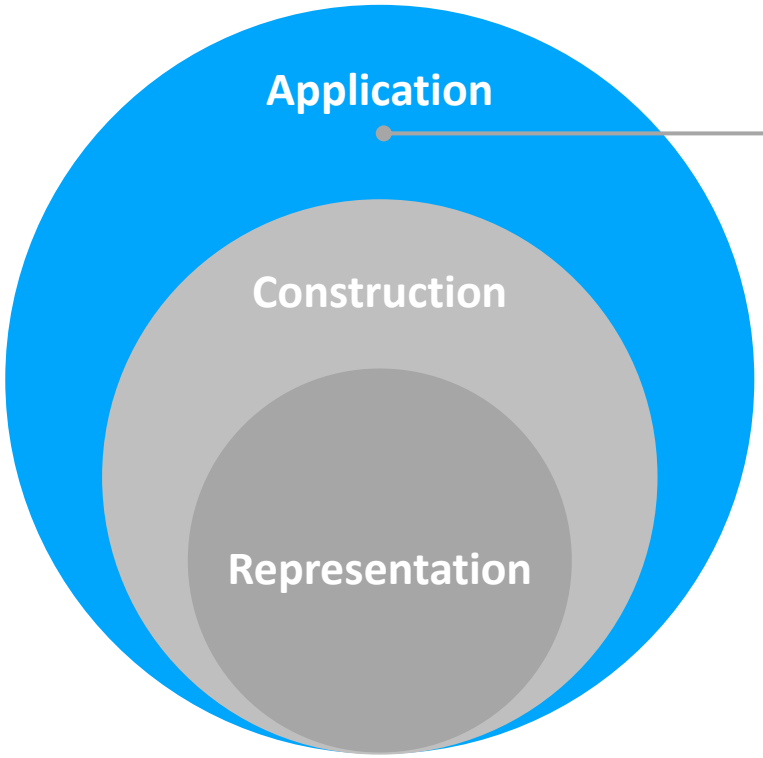
graph vs. tree vs. hybrid structure



	Graph	Tree
Expressiveness	high	limited
Usability	limited	high
Global links	yes	no

How can we balance expressiveness and usability in knowledge organization?

Utilize KG as Execution Method



Execution Method

Enable reasoning and computation over knowledge for task execution

Utilize KG as Execution Method

KG as a method to support reasoning and computation over knowledge

- Traditionally, Knowledge computing has been largely focused on predicting facts

- Beyond fact prediction, structured knowledge enables richer computation and analysis over its structure

count

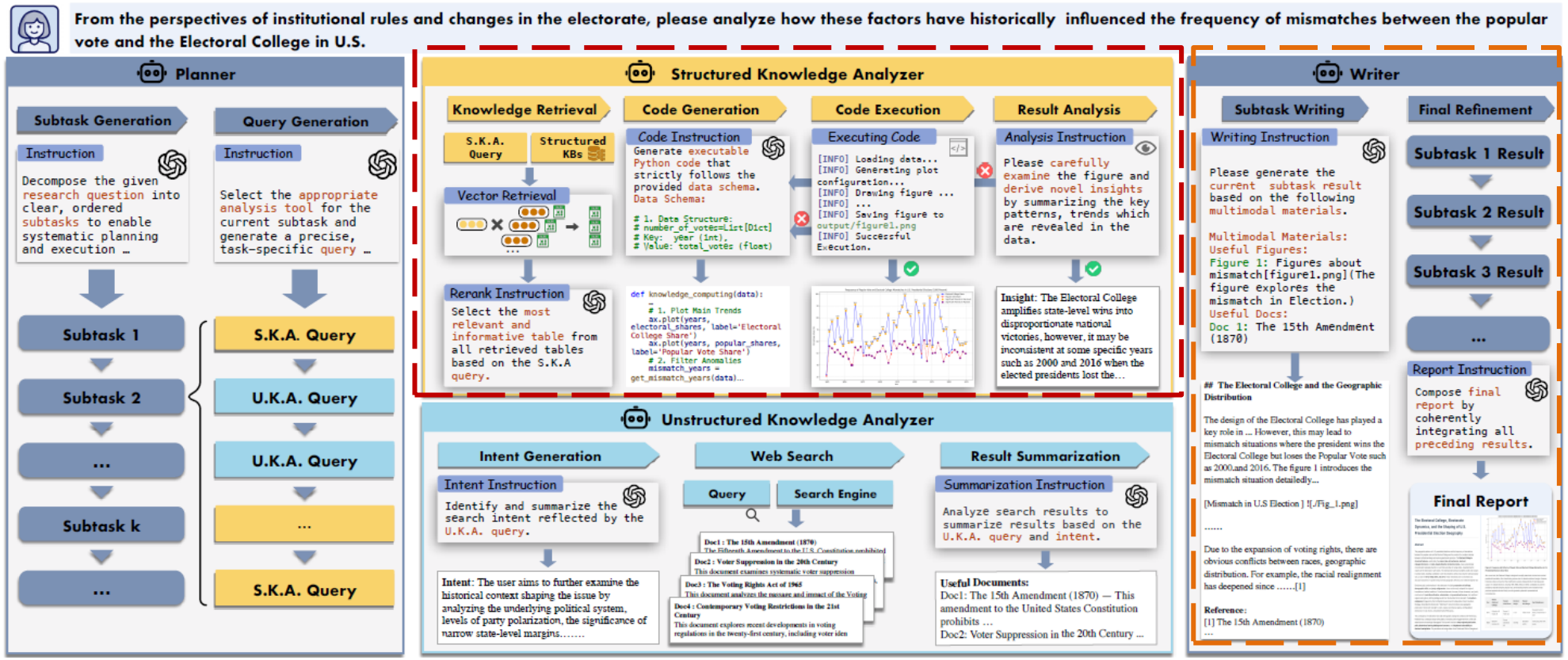
statistic

trend

...

Utilize KG as Execution Method

Integrate computation over structured knowledge into the deep research process



- Generate table/chart via code execution
- Analyze table/chart via VL model
- Integrate information from webpage and structured knowledge
- Generate multimodal analysis report

Summary

- Beyond knowledge graphs themselves, many KG techniques remain valuable in agentic AI
- Advanced agent systems demand new knowledge organization methods
- Knowledge computing should go far beyond fact prediction
- Structured knowledge is essential, but not necessarily in the form of knowledge graph

Knowledge Engineering?

THANKS

bailong@ict.ac.cn