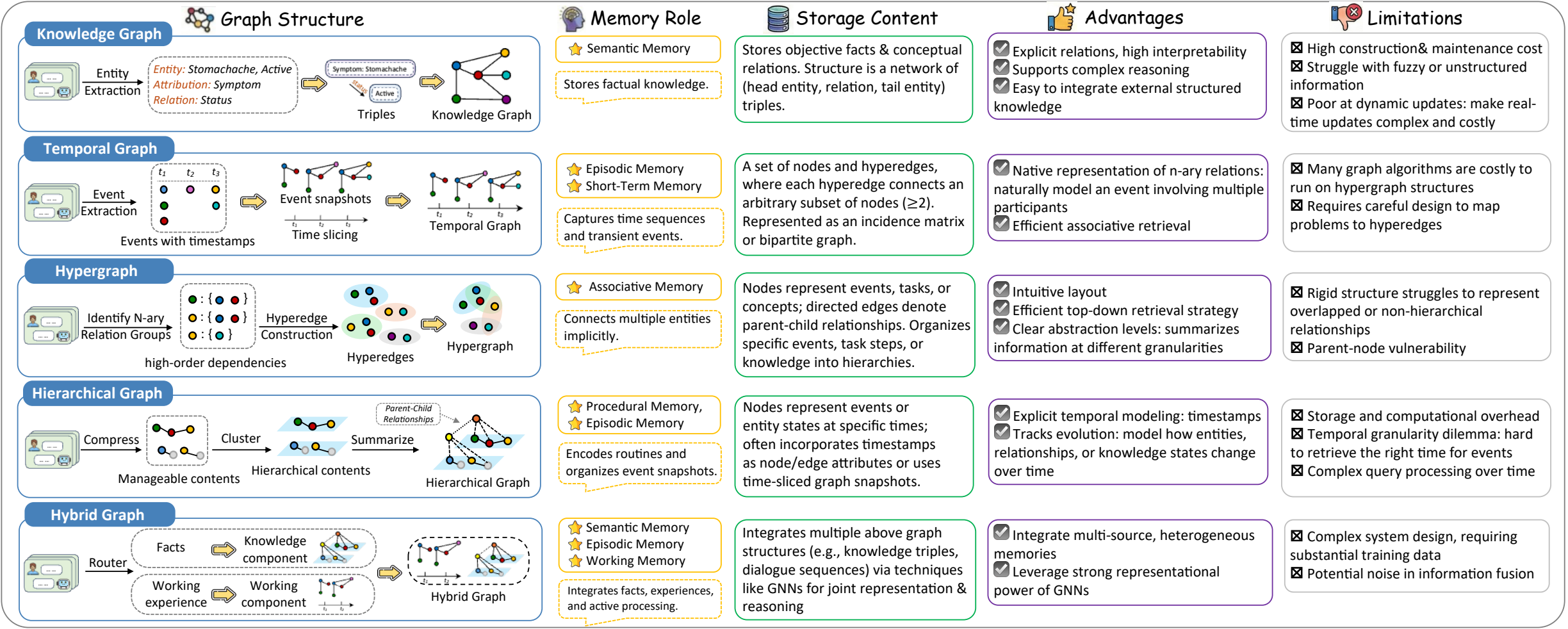
Graph Structure
Memory Role
Storage Content
Advantages
Limitations
Knowledge Graph
Entity Extraction
Entity: Stomachache, Active
Attribution: Symptom
Relation: Status
Symptom: Stomachache
status
Active
Triples
Knowledge Graph
Semantic Memory
Stores factual knowledge.
Stores objective facts & conceptual relations. Structure is a network of (head entity, relation, tail entity) triples.
Explicit relations, high interpretability
Supports complex reasoning
Easy to integrate external structured knowledge
High construction& maintenance cost
Struggle with fuzzy or unstructured information
Poor at dynamic updates: make real-time updates complex and costly
Temporal Graph
Event Extraction
Events with timestamps
Event snapshots
Time slicing
Temporal Graph
Episodic Memory
Short-Term Memory
Captures time sequences and transient events.
A set of nodes and hyperedges, where each hyperedge connects an arbitrary subset of nodes (≥2). Represented as an incidence matrix or bipartite graph.
Native representation of n-ary relations: naturally model an event involving multiple participants
Efficient associative retrieval
Many graph algorithms are costly to run on hypergraph structures
Requires careful design to map problems to hyperedges
Hypergraph
Identify N-ary Relation Groups
high-order dependencies
Hyperedge Construction
Hyperedges
Hypergraph
Associative Memory
Connects multiple entities implicitly.
Nodes represent events, tasks, or concepts; directed edges denote parent-child relationships. Organizes specific events, task steps, or knowledge into hierarchies.
Intuitive layout
Efficient top-down retrieval strategy
Clear abstraction levels: summarizes information at different granularities
Rigid structure struggles to represent overlapped or non-hierarchical relationships
Parent-node vulnerability
Hierarchical Graph
Compress
Manageable contents
Cluster
Hierarchical contents
Summarize
Parent-Child Relationships
Hierarchical Graph
Procedural Memory,
Episodic Memory
Encodes routines and organizes event snapshots.
Nodes represent events or entity states at specific times; often incorporates timestamps as node/edge attributes or uses time-sliced graph snapshots.
Explicit temporal modeling: timestamps
Tracks evolution: model how entities, relationships, or knowledge states change over time
Storage and computational overhead
Temporal granularity dilemma: hard to retrieve the right time for events
Complex query processing over time
Hybrid Graph
Router
Facts
Knowledge component
Working experience
Working component
Hybrid Graph
Semantic Memory
Episodic Memory
Working Memory
Integrates facts, experiences, and active processing.
Integrates multiple above graph structures (e.g., knowledge triples, dialogue sequences) via techniques like GNNs for joint representation & reasoning
Integrate multi-source, heterogeneous memories
Leverage strong representational power of GNNs
Complex system design, requiring substantial training data
Potential noise in information fusion