


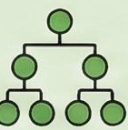
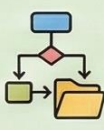
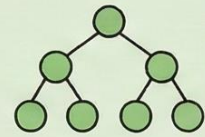
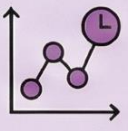

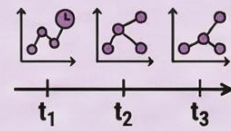
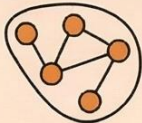

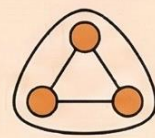
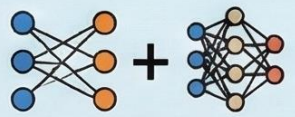

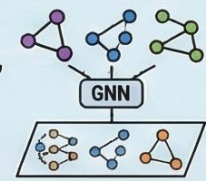


Graph Structure	Memory Type & Role	Storage Content	Key Advantages	Main Limitations
 Knowledge Graph	 Long-Term Memory / World Knowledge / Factual Memory	<p>Stores objective facts & conceptual relations. Structure is a network of (head entity, relation, tail entity) triples.</p> 	<ul style="list-style-type: none"> ✓ Explicit relations, high interpretability. ✓ Supports complex reasoning (e.g., multi-hop queries). ✓ Easy to integrate external structured knowledge. 	<ul style="list-style-type: none"> ✗ High construction & maintenance cost. ✗ Struggle with fuzzy or unstructured information. ✗ Poor at dynamic updates: make real-time updates complex and costly.
 Hierarchical Graph / Tree	 Episodic / Procedural / Organizational Memory.	<p>Nodes represent events, tasks, or concepts; directed edges denote parent-child relationships. Organizes specific events, task steps, or knowledge into containment hierarchies.</p> 	<ul style="list-style-type: none"> ✓ Intuitive layout. ✓ Efficient top-down retrieval strategy. ✓ Clear abstraction levels – Summarizes information at different granularities. 	<ul style="list-style-type: none"> ✗ Rigid structure struggles to represent overlapped or non-hierarchical relationships. ✗ Parent-node vulnerability.
 Dynamic/Temporal Graph	 Episodic / Autobiographical Memory.	<p>Nodes represent events or entity states at specific times; often incorporates timestamps as node/edge attributes or uses time-sliced graph snapshots.</p> 	<ul style="list-style-type: none"> ✓ Explicit temporal modeling: clearly show timestamps. ✓ Tracks evolution: can model how entities, relationships, or knowledge states change over time. 	<ul style="list-style-type: none"> ✗ Storage and computational overhead. ✗ Temporal granularity dilemma: hard to retrieve the right time for events. ✗ Complex query processing over time.
 Hypergraph	 Episodic / Associative Memory.	<p>A set of nodes and hyperedges, where each hyperedge connects an arbitrary subset of nodes (≥ 2). Represented as an incidence matrix or bipartite graph.</p> 	<ul style="list-style-type: none"> ✓ Native representation of n-ary relations: naturally model an event involving multiple participants. ✓ Efficient associative retrieval. 	<ul style="list-style-type: none"> ✗ Computational complexity. Many graph algorithms are harder and more costly to run on hypergraph structures. ✗ Requires careful design to map problems to hyperedges.
 Hybrid Graph	 Integrated Memory System	<p>Integrates multiple above graph structures (e.g., knowledge triples, dialogue sequences) via techniques like GNNs for joint representation & reasoning.</p> 	<ul style="list-style-type: none"> ✓ Can integrate multi-source, heterogeneous memory information. ✓ Leverages strong representational power of GNNs. 	<ul style="list-style-type: none"> ✗ Complex system design, requires substantial training data. ✗ Potential noise in information fusion.