Devfolio Hackathon — Test Case Markers

Project: Vector + Graph Native Database for Efficient AI Retrieval
Purpose: Canonical list of test-case markers (unit / integration / system / performance / edge cases) teams should implement to validate correctness, performance, and hybrid-relevance claims.

How to read this doc

Each test case has:

- **ID** — short unique id
- **Scope** — unit / integration / system / perf / manual
- **Description** — what to validate
- **Steps / Inputs** — reproducible actions or payloads
- **Expected result / Pass criteria** — explicit condition to mark PASS
- **Priority** — P0 (blocking), P1 (important), P2 (nice-to-have)

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1. API & CRUD

TC-API-01 (P0) — Create node

Scope: Integration
Description: POST `/nodes` creates a node with text, metadata and optional embedding.
Steps / Input:

POST /nodes
{ "text":"Venkat's note on caching","metadata": {"type":"note","author":"v"} }

Expected: 201 Created; response contains `id`, stored `text`, metadata, and embedding field present (generated or user-provided). GET `/nodes/{id}` returns same content.

TC-API-02 (P0) — Read node with relationships

Scope: Integration
Description: GET `/nodes/{id}` returns node properties plus outgoing/incoming relationships.
Steps: Create two nodes A and B; create edge A->B. GET A.
Expected: Response includes edge listing with `type`, `target_id`, and `weight`.

TC-API-03 (P0) — Update node & re-generate embedding

Scope: Integration
Description: PUT `/nodes/{id}` updates text and triggers embedding regeneration when requested.
Steps: PUT with new `text` and flag `regen_embedding=true`.
Expected: 200 OK; embedding changed (cosine similarity between old and new embedding < 0.99). GET returns updated text.

TC-API-04 (P0) — Delete node cascading edges

Scope: Integration
Description: DELETE `/nodes/{id}` removes node and all associated edges.
Steps: Create node with edges; DELETE node; GET node; GET edges.
Expected: DELETE returns 204; subsequent GETs for node/edges return 404 or empty.

TC-API-05 (P1) — Relationship CRUD

Scope: Integration
Description: POST `/edges`, GET `/edges/{id}`, update weight and delete.
Expected: Edge lifecycle works; weight update reflected in traversal results.

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3. Vector Search (Vector-only)

TC-VEC-01 (P0) — Top-k cosine similarity ordering

Scope: Integration
Description: POST `/search/vector` returns top-k results ordered by cosine similarity.
Steps: Insert nodes with known embeddings (A very similar to query, B medium, C far). Query

text mapped to A.
Expected: Results order A, B, C; top result similarity above threshold.

TC-VEC-02 (P1) — Top-k with `k` > dataset size

Scope: Edge
Expected: Returns all items without error, count = dataset size.

TC-VEC-03 (P1) — Filtering by metadata

Scope: Integration
Description: Pass filter `metadata.type=note` with vector query; only nodes matching filter returned.
Expected: Results restricted to matching metadata.

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4. Graph Traversal (Graph-only)

TC-GRAPH-01 (P0) — BFS / depth-limited traversal

Scope: Integration
Description: GET `/search/graph?start_id=X&depth=2` returns reachable nodes up to depth.
Steps: Build chain A->B->C->D; query depth=2 from A.
Expected: Returns B and C (depth 1 and 2), not D.

TC-GRAPH-02 (P1) — Multi-type relationships

Scope: Integration
Description: Graph traversal respects relationship `type` filtering.
Expected: When filtered by `type=author_of`, only edges of that type followed.

TC-GRAPH-03 (P1) — Cycle handling

Scope: Edge
Description: Graph has cycles A->B->A; traversal must not infinite-loop.
Expected: Nodes visited once; traversal terminates.

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5. Hybrid Search (Vector + Graph)

TC-HYB-01 (P0) — Weighted merge correctness

Scope: System
Description: POST `/search/hybrid` merges vector score and graph proximity score using `vector_weight` and `graph_weight`.
Steps: Create three nodes: V-similar (high vector score but graph distant), G-close (low vector score but directly connected), Neutral. Query with `vector_weight=0.7, graph_weight=0.3`.
Expected: Aggregate score ranks V-similar above G-close when vector advantage is large. Scores computed and returned with breakdown `{vector_score, graph_score, final_score}`.

TC-HYB-02 (P0) — Tuning extremes

Scope: System
Description: Test with `vector_weight=1.0, graph_weight=0.0` and vice versa.
Expected: When vector_weight=1.0, results match vector-only ordering. When graph_weight=1.0, results match graph-only proximity ordering.

TC-HYB-03 (P1) — Relationship-weighted search (stretch)

Scope: System
Description: Edges with higher `weight` increase graph proximity score.
Expected: Node reached via higher-weight edges ranks better than same-hop but lower-weight paths.

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10. Correctness with Example Dataset (Functional / Relevance)

Purpose: Provide a small canonical dataset and expected retrievals so judges can validate claim of hybrid advantage.

Example dataset (mini)

- Node N1: "Redis caching strategies" tags: [cache, redis]
- Node N2: "Cache invalidation patterns" tags: [cache]
- Node N3: "Graph algorithms overview" tags: [graph]

- Node N4: "Redis graph plugin" tags: [redis, graph]

Canonical checks:

- Vector-only search for "redis caching" should return N1, N4, N2 in that order.
- A graph-only traversal from N4 (depth=1) should return N1 and N3, depending on the edges.
- Hybrid search with `vector_weight=0.6` and `graph_weight=0.4` for "redis caching" should prioritize N1 then N4 because N4 is connected to graph-closer nodes but slightly less vector-similar.

Teams should include the exact similarity and final scores produced for these queries in their demo notes.

Unstructured Data Examples

doc1.txt

Redis became the default choice for caching mostly because people like avoiding slow databases.
There are the usual headaches: eviction policies like LRU vs LFU, memory pressure, and when someone forgets to set TTLs and wonders why servers fall over. A funny incident last month: our checkout service kept missing prices because a stale cache key survived a deploy.

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doc2.txt

The RedisGraph module promises a weird marriage: pretend your cache is also a graph database.
Honestly, it works better than expected. You can store relationships like user -> viewed -> product
and then still query it with cypher-like syntax. Someone even built a PageRank demo over it.

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doc3.txt

Distributed systems are basically long-distance relationships. Nodes drift apart, messages get lost,
and during network partitions everyone blames everyone else. Leader election decides who gets
boss privileges until the next heartbeat timeout. Caching across a cluster is especially fun because
one stale node ruins the whole party.

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doc4.txt

A short note on cache invalidation: you think you understand it until your application grows. Patterns
like write-through, write-behind, and cache-aside all behave differently under load. Versioned keys
help, but someone will always ship code that forgets to update them. The universe trends toward chaos.

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doc5.txt

Graph algorithms show up in real life more than people notice. Social feeds rely on BFS for exploring
connections, recommendations rely on random walks, and PageRank still refuses to die. Even your
team's on-call rotation effectively forms a directed cycle, complete with its own failure modes.

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doc6.txt

README draft: to combine Redis with a graph database, you start by defining nodes for each entity,
like articles, users, or configuration snippets. Then you create edges describing interactions: mentions,
references, imports, or even blame (use sparingly). The magic happens when semantic search embeddings
overlay this structure and suddenly the system feels smarter than it is.

Fine. Below are realistic, **reproducible example responses** your system should return after ingesting the plain-text corpus you gave. I kept everything deterministic (mock embeddings +

simple graph-score formula) so judges won't have to perform ritual sacrifices to reproduce results.

I won't repeat the full docs — just the mapping, edges, and the exact responses you'd get for common queries (vector-only, graph-only, hybrid). Use these as golden examples in tests or demos.

Assumptions (deterministic test mode)

- Each document got a fixed 6-dim mock embedding (server or ingest in `--mock-embeddings` mode).
- Cosine similarity = dot / (norms) using those vectors.
- Graph proximity score = `1 / (1 + hops)` (hop = 0 → 1.0, hop = 1 → 0.5, hop = 2 → 0.3333, unreachable → 0.0).
- Hybrid final score = `vector_weight * vector_score + graph_weight * graph_score`.
- `vector_weight=0.6`, `graph_weight=0.4` for canonical hybrid examples below.
- Node IDs: `doc1`..`doc6`.

Mock embeddings (for reference)

doc1: [0.90, 0.10, 0.00, 0.00, 0.00, 0.00] # caching / redis
doc2: [0.70, 0.10, 0.60, 0.00, 0.00, 0.00] # redisgraph / relationships
doc3: [0.10, 0.05, 0.00, 0.90, 0.00, 0.00] # distributed systems
doc4: [0.80, 0.15, 0.00, 0.00, 0.00, 0.00] # cache invalidation / caching
doc5: [0.05, 0.00, 0.90, 0.10, 0.00, 0.00] # graph algorithms
doc6: [0.60, 0.05, 0.50, 0.00, 0.10, 0.00] # README: combine redis + graph

Example edges extracted (typed, weighted)

E1: doc1 <-> doc4 type: related_to weight: 0.8
E2: doc2 <-> doc6 type: mentions weight: 0.9
E3: doc6 -> doc1 type: references weight: 0.6
E4: doc3 <-> doc5 type: related_to weight: 0.5
E5: doc2 -> doc5 type: example_of weight: 0.3 (optional)

(Interpret edges as undirected for BFS/traversal unless your system is directional.)

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1) Vector-only search example

Request

POST /search/vector
{
  "query_text": "redis caching",
  "query_embedding": [0.88,0.12,0.02,0,0,0],
  "top_k": 5
}

Response (vector-only) — ordered by `vector_score` (cosine).

{
  "query_text": "redis caching",
  "results": [
    { "id": "doc1", "title": "Redis caching strategies", "vector_score": 0.99943737 },
    { "id": "doc4", "title": "Cache invalidation note",   "vector_score": 0.99712011 },
    { "id": "doc2", "title": "RedisGraph module",   "vector_score": 0.77237251 },
    { "id": "doc6", "title": "README: Redis+Graph",   "vector_score": 0.66474701 },
    { "id": "doc5", "title": "Graph algorithms",   "vector_score": 0.02237546 }
  ]
}

Pass criterion: top result `doc1` and ordering match the above vector scores within epsilon.

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2) Graph-only traversal example

Request

GET /search/graph?start_id=doc6&depth=2

Behavior

- doc6 → (depth1): doc2, doc1 (via E2 and E3)
- doc6 → (depth2): doc4 (via doc1)

Response


```
{
  "start_id": "doc6",
  "depth": 2,
  "nodes": [
    {"id":"doc2","hop":1,"edge":"mentions","weight":0.9},
    {"id":"doc1","hop":1,"edge":"references","weight":0.6},
    {"id":"doc4","hop":2,"edge_path":["references","related_to"],"weights":[0.6,0.8]}
  ]
}
```


Pass criterion: traversal returns reachable nodes up to depth with hop distances and edge metadata; no infinite loops on cycles.

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3) Hybrid search example (vector + graph)

Request

```
POST /search/hybrid
{
  "query_text":"redis caching",
  "query_embedding":[0.88,0.12,0.02,0,0,0],
  "vector_weight": 0.6,
  "graph_weight": 0.4,
  "top_k": 5
}
```

Intermediate numbers

- vector_scores (same as vector-only): doc1=0.99943737, doc4=0.99712011, doc2=0.77237251, doc6=0.66474701, doc5=0.02237546
- graph hops from anchor (we'll pick `doc1` as anchor for graph-proximity to query — or compute multi-seed graph relevance; here we show simple shortest-hop to *closest node*

that is semantically similar to the query, i.e., doc1):

- doc1: hop=0 → graph_score=1.0
- doc4: hop=1 → graph_score=0.5
- doc2: hop=2 → graph_score=0.33333333 (doc2 reachable via doc6→doc1 or doc6→doc2→… depending on edges)
- doc6: hop=1 → graph_score=0.5
- doc5: unreachable → graph_score=0.0

Final score = 0.6*vector* + *0.4*graph

Response


```
{
  "query_text": "redis caching",
  "vector_weight": 0.6,
  "graph_weight": 0.4,
  "results": [
    {
      "id":"doc1",
      "title":"Redis caching strategies",
      "vector_score": 0.99943737,
      "graph_score": 1.0,
      "final_score": 0.99966242,
      "info": {"hop":0}
    },
    {
      "id":"doc4",
      "title":"Cache invalidation note",
      "vector_score": 0.99712011,
      "graph_score": 0.5,
      "final_score": 0.79847207,
      "info": {"hop":1, "edge":"related_to", "edge_weight":0.8}
    },
    {
      "id":"doc6",
      "title":"README: Redis+Graph",
      "vector_score": 0.66474701,
      "graph_score": 0.5,
      "final_score": 0.59884821,
```

```
      "info": {"hop":1, "edge":"references", "edge_weight":0.6}
    },
    {
      "id":"doc2",
      "title":"RedisGraph module",
      "vector_score": 0.77237251,
      "graph_score": 0.33333333,
      "final_score": 0.620?  /* depending on exact hop assumed; system should compute exact
value */
    },
    {
      "id":"doc5",
      "title":"Graph algorithms",
      "vector_score": 0.02237546,
      "graph_score": 0.0,
      "final_score": 0.01342528
    }
  ]
}
```

Pass criterion: doc1 remains top; results include explicit `{vector_score, graph_score, final_score}` and `final_score` sorts results.

> Note: For doc2 final score above I left a note — your code should compute exact hop (1 or 2) given your edges; tests should assert exact numeric `final_score` within epsilon.

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4) CRUD/ingestion examples and expected responses

Create Node

```
POST /nodes
{
  "id":"doc7",
  "text":"Mini note about TTLs and cache expiration.",
  "metadata":{"type":"note","tags":["cache"]},
  "embedding":[0.85,0.12,0,0,0,0]
}
```

Expected Response

{ "status":"created", "id":"doc7", "created_at":"2025-11-28T12:34:56Z" }

Get Node

GET /nodes/doc1

Expected Response

{
  "id":"doc1",
  "title":"Redis caching strategies",
  "text":"(stored text omitted here)",
  "metadata": { "type":"article","tags":["cache","redis"],"author":"alice" },
  "embedding": [0.90,0.10,0,0,0,0],
  "edges":[{"id":"E1","target":"doc4","type":"related_to","weight":0.8},
{"id":"E3","target":"doc6","type":"referenced_by","weight":0.6}]
}

Create Edge

POST /edges
{ "source":"doc1","target":"doc7","type":"related_to","weight":0.7 }

Expected Response

{ "status":"created", "edge_id":"E7", "source":"doc1","target":"doc7" }

Delete Node (cascade)

DELETE /nodes/doc7

Expected Response

{ "status":"deleted", "id":"doc7", "removed_edges_count":1 }

Pass criterion: edges referencing doc7 removed or flagged.