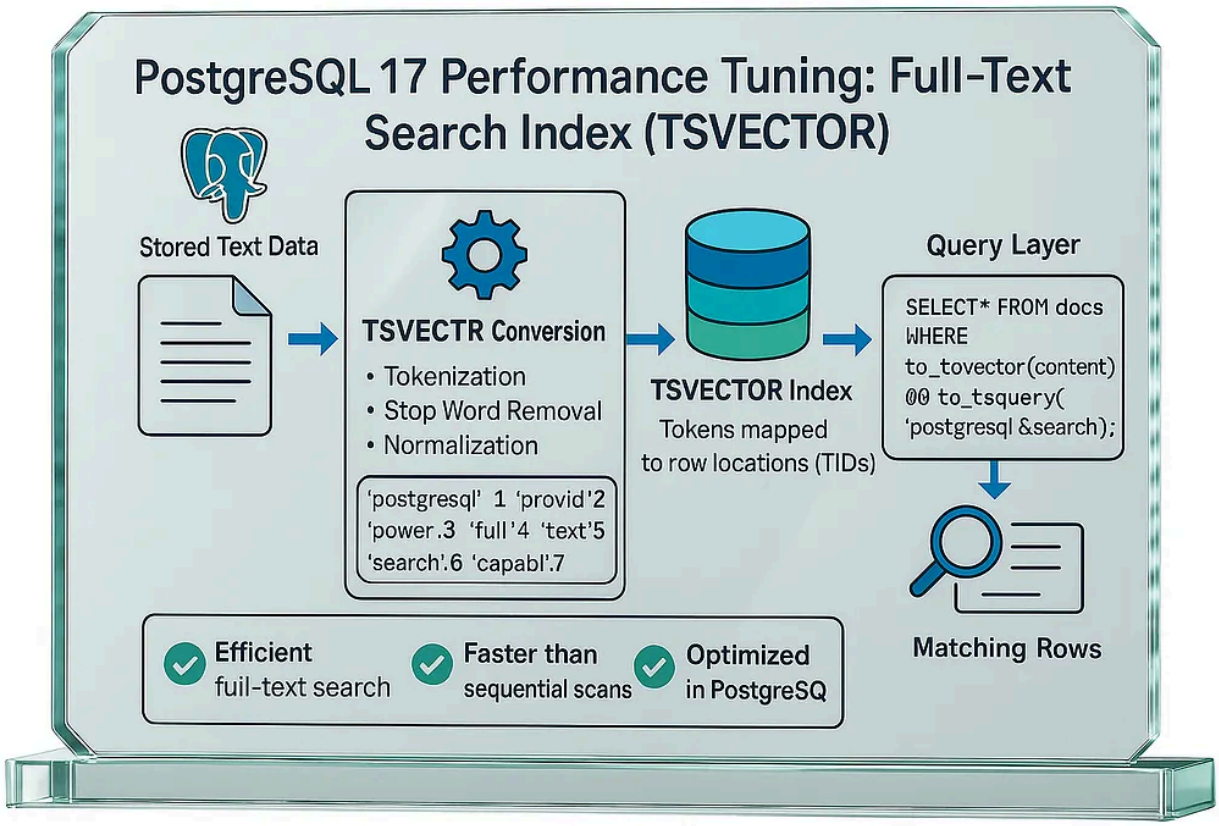
20 - PostgreSQL 17 Performance Tuning: Full-Text Search Index (TSVECTOR

4 min read · Sep 5, 2025

Jeyaram Ayyalusamy Following



A **Full-Text Search Index (TSVECTOR)** in PostgreSQL is a special way of indexing text data so that it can be searched quickly and efficiently. Instead of storing raw text, PostgreSQL converts the text into a `tsvector`, which is a preprocessed form

that breaks the text into tokens (words), removes stop words (like “a”, “the”), and normalizes words to their root form (e.g., “running”, “ran” → “run”).

This `tsvector` is then indexed, usually with a **GIN (Generalized Inverted Index)** or **GiST (Generalized Search Tree)** index, which allows PostgreSQL to match search queries (`tsquery`) against documents at high speed.

By using `tsvector` , PostgreSQL supports full-text search features like:

- Finding documents that contain specific words or phrases.
- Ranking results based on relevance.
- Highlighting matched words in search results.

In short, a Full-Text Search Index with `tsvector` transforms text into a searchable format and, when combined with an index, provides fast and accurate full-text search inside PostgreSQL.

Step 1 — Create the table

```
CREATE TABLE articles (
    id           BIGSERIAL PRIMARY KEY,
    title        TEXT,
    body         TEXT,
    published_at TIMESTAMPTZ DEFAULT now()
);
```

```
postgres=#
postgres=# CREATE TABLE articles (
    id           BIGSERIAL PRIMARY KEY,
    title        TEXT,
    body         TEXT,
```

```
    published_at TIMESTAMPTZ DEFAULT now()
);
CREATE TABLE
postgres=#
```

Step 2 — Load 1,000,000 rows (synthetic corpus)

We'll sprinkle common tech keywords so the search actually matches.

```
INSERT INTO articles (title, body)
SELECT
  'Post ' || g || ' about ' ||
    (ARRAY['database','performance','indexing','postgresql','tuning',
           'sql','json','cache','query','optimizer'])
      [1 + (random()*9)::int] AS title,
  'This article discusses ' ||
    (ARRAY['database','performance tuning','indexing strategies','PostgreSQL 17
           'GIN indexes','full-text search','planning and costing','caching','
      [1 + (random()*9)::int] ||
  ' with practical tips on ' ||
    (ARRAY['tsvector','tsquery','plainto_tsquery','to_tsquery','ranking','highl
      [1 + (random()*5)::int] || '.' AS body
FROM generate_series(1, 1000000) g;
```

```
postgres=# INSERT INTO articles (title, body)
SELECT
  'Post ' || g || ' about ' ||
    (ARRAY['database','performance','indexing','postgresql','tuning',
           'sql','json','cache','query','optimizer'])
      [1 + (random()*9)::int] AS title,
  'This article discusses ' ||
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           'GIN indexes','full-text search','planning and costing','caching','
      [1 + (random()*9)::int] ||
  ' with practical tips on ' ||
    (ARRAY['tsvector','tsquery','plainto_tsquery','to_tsquery','ranking','highl
```

```
      [1 + (random()*5)::int] || '.' AS body
FROM generate_series(1, 1000000) g;
```

Step 3 — Analyze statistics

```
ANALYZE articles;
```

```
postgres=# ANALYZE articles;
ANALYZE
postgres=#
```

Step 4 — Baseline query without an index

We'll search for "**database performance**". Computing the vector on the fly forces a full scan.

```
EXPLAIN ANALYZE
SELECT count(*)
FROM articles
WHERE to_tsvector('english', coalesce(title,'') || ' ' || coalesce(body,'')) @@
      plainto_tsquery('english','database performance');
```

```
postgres=# EXPLAIN ANALYZE
SELECT count(*)
FROM articles
WHERE to_tsvector('english', coalesce(title,'') || ' ' || coalesce(body,'')) @@
      plainto_tsquery('english','database performance');

------------------------------------------------------------------------------
 Finalize Aggregate  (cost=130449.57..130449.58 rows=1 width=8) (actual time=13
   ->  Gather  (cost=130449.36..130449.57 rows=2 width=8) (actual time=13184.60
         Workers Planned: 2
         Workers Launched: 2
         ->  Partial Aggregate  (cost=129449.36..129449.37 rows=1 width=8) (act
               ->  Parallel Seq Scan on articles  (cost=0.00..129449.33 rows=10
                     Filter: (to_tsvector('english'::regconfig, ((COALESCE(titl
                     Rows Removed by Filter: 329211
 Planning Time: 0.090 ms
 Execution Time: 13191.826 ms
(10 rows)
```

```
postgres=#
```

```
Time: 13191.826 ms (00:13.826)
postgres=#
```

> With no index, PostgreSQL scans all 1M rows (~*13.826* s).

Step 5 — Add a generated `tsvector` column (stored)

This keeps document vectors always up-to-date without triggers.

```
ALTER TABLE articles
ADD COLUMN tsv tsvector
GENERATED ALWAYS AS (
```

```
  to_tsvector('english', coalesce(title,'') || ' ' || coalesce(body,''))
) STORED;
```

```
postgres=# postgres=# ALTER TABLE articles
ADD COLUMN tsv tsvector
GENERATED ALWAYS AS (
  to_tsvector('english', coalesce(title,'') || ' ' || coalesce(body,''))
) STORED;
ALTER TABLE
postgres=#
```

Step 6 — Create a GIN index on the `tsvector`

```
CREATE INDEX idx_articles_tsv_gin ON articles USING gin (tsv);
```

```
postgres=# CREATE INDEX idx_articles_tsv_gin ON articles USING gin (tsv);
CREATE INDEX
postgres=#
```

(If building online in production, use `CREATE INDEX CONCURRENTLY`.)

Analyze statistics

```
ANALYZE articles;
```

```
postgres=# ANALYZE articles;
ANALYZE
postgres=#
```

Step 7 — Search again (now using the index)

```
postgres=# EXPLAIN ANALYZE
SELECT count(*)
FROM articles
WHERE tsv @@ plainto_tsquery('english','database performance');
                                                                  QUERY PLAN
-----------------------------------------------------------------------------------------
 Aggregate  (cost=34497.68..34497.69 rows=1 width=8) (actual time=39.425..39.42
   ->  Bitmap Heap Scan on articles  (cost=190.83..34440.90 rows=22714 width=0)
         Recheck Cond: (tsv @@ '''databas'' & ''perform'''::tsquery)
         Heap Blocks: exact=10602
         ->  Bitmap Index Scan on idx_articles_tsv_gin  (cost=0.00..185.15 rows
               Index Cond: (tsv @@ '''databas'' & ''perform'''::tsquery)
 Planning Time: 0.101 ms
 Execution Time: 39.453 ms
(8 rows)
```

```
postgres=#
```

```
Time: 39.453 ms
postgres=#
```

> GIN flips the plan to **Bitmap Index Scan**, dropping runtime from ***Time reduction:*** *(13,191.826 − 39.453) =* ***13,152.373 ms*** *saved (≈* ***99.701%*** *reduction)*

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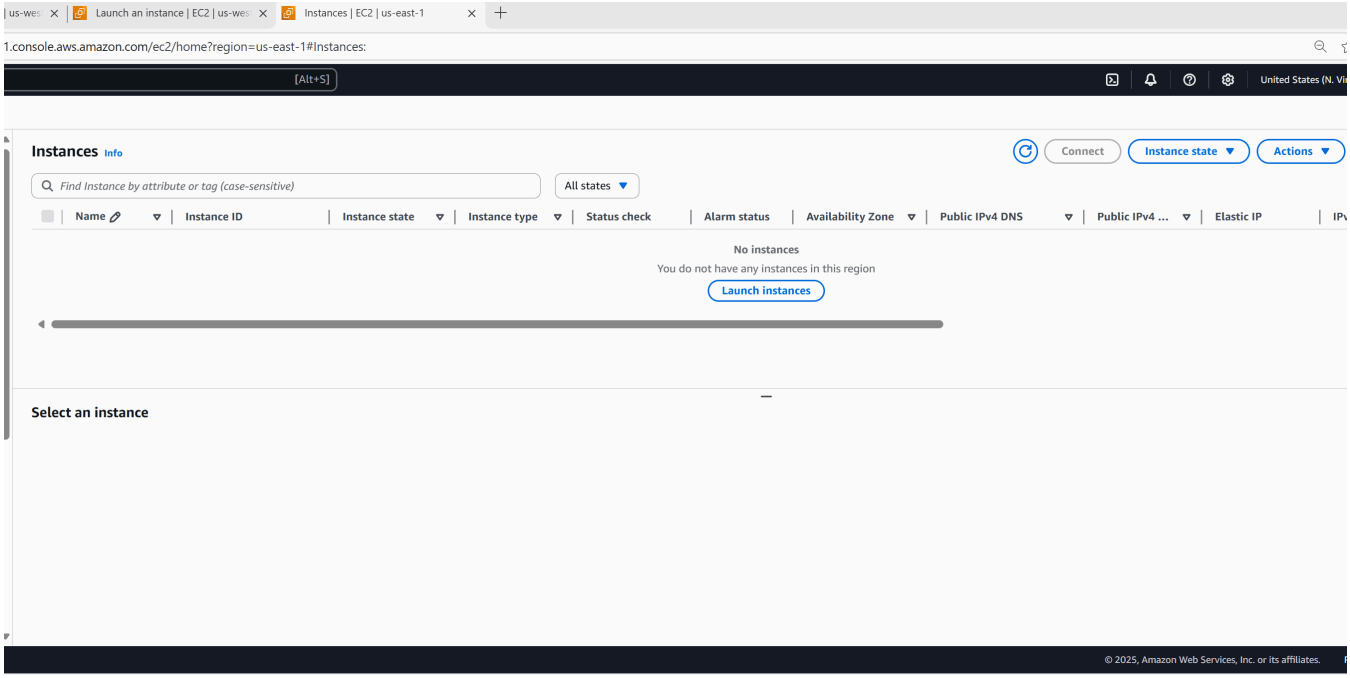

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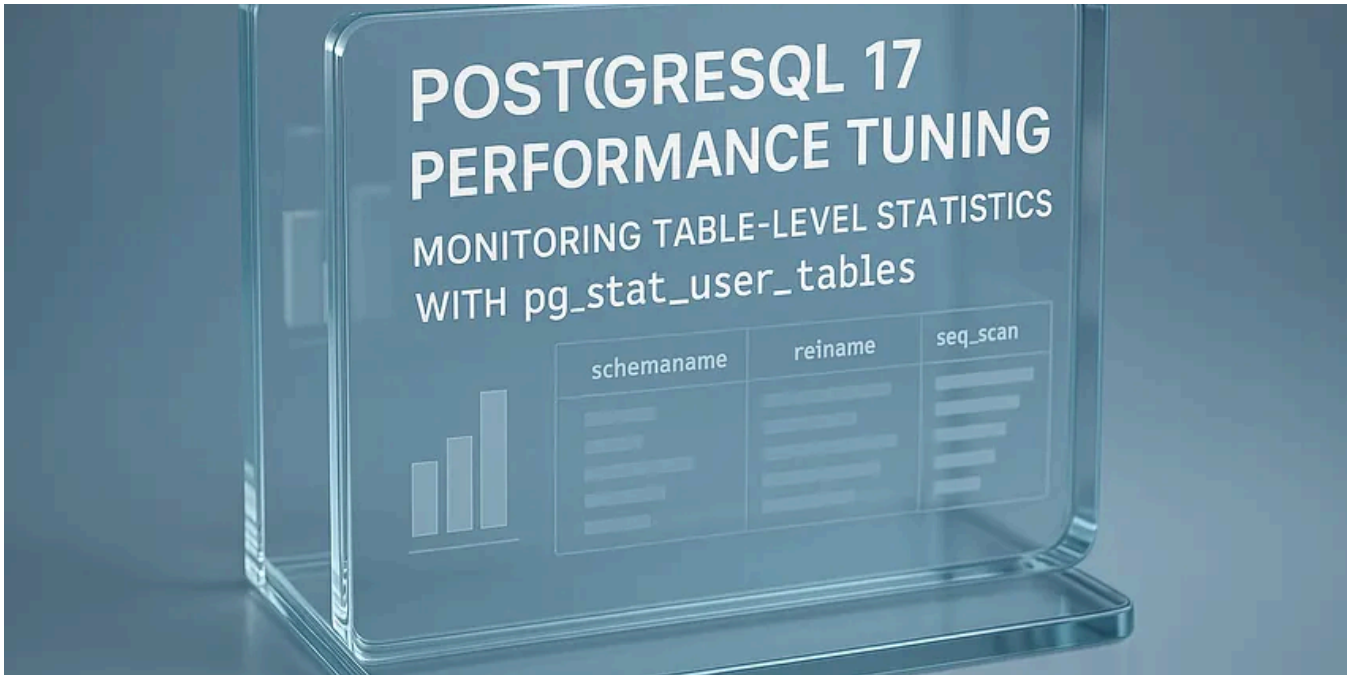

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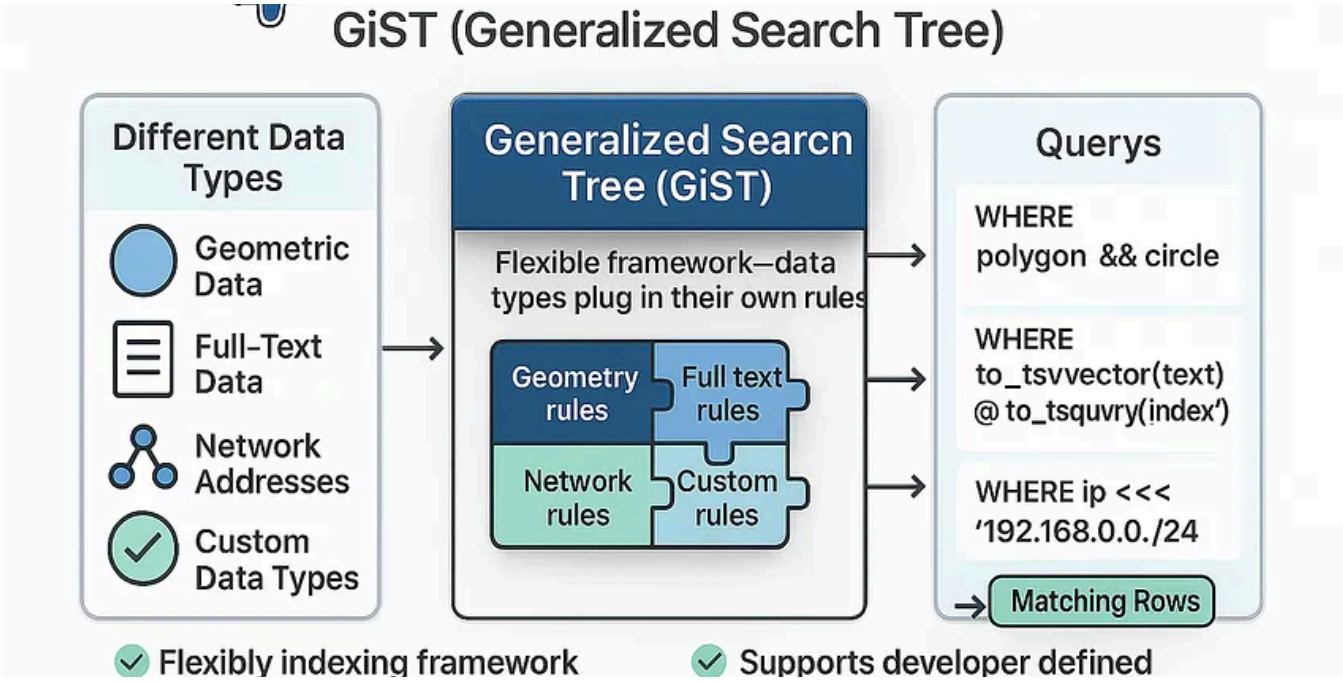

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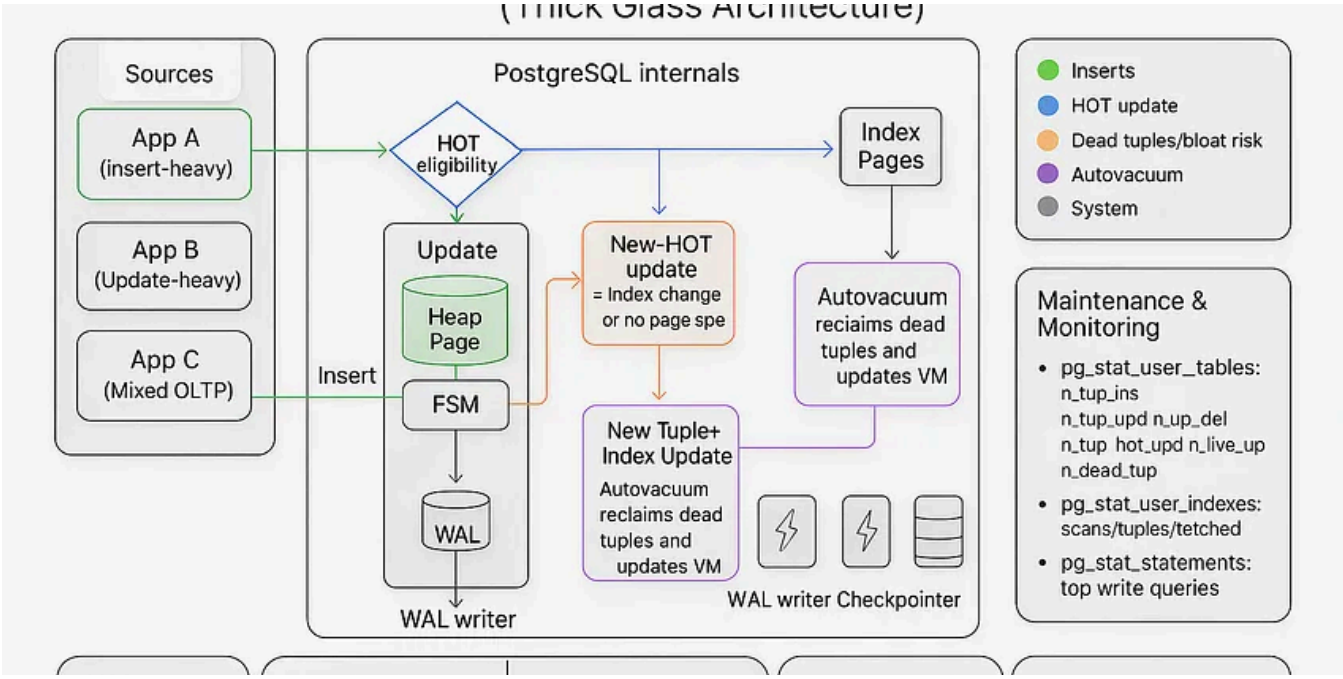

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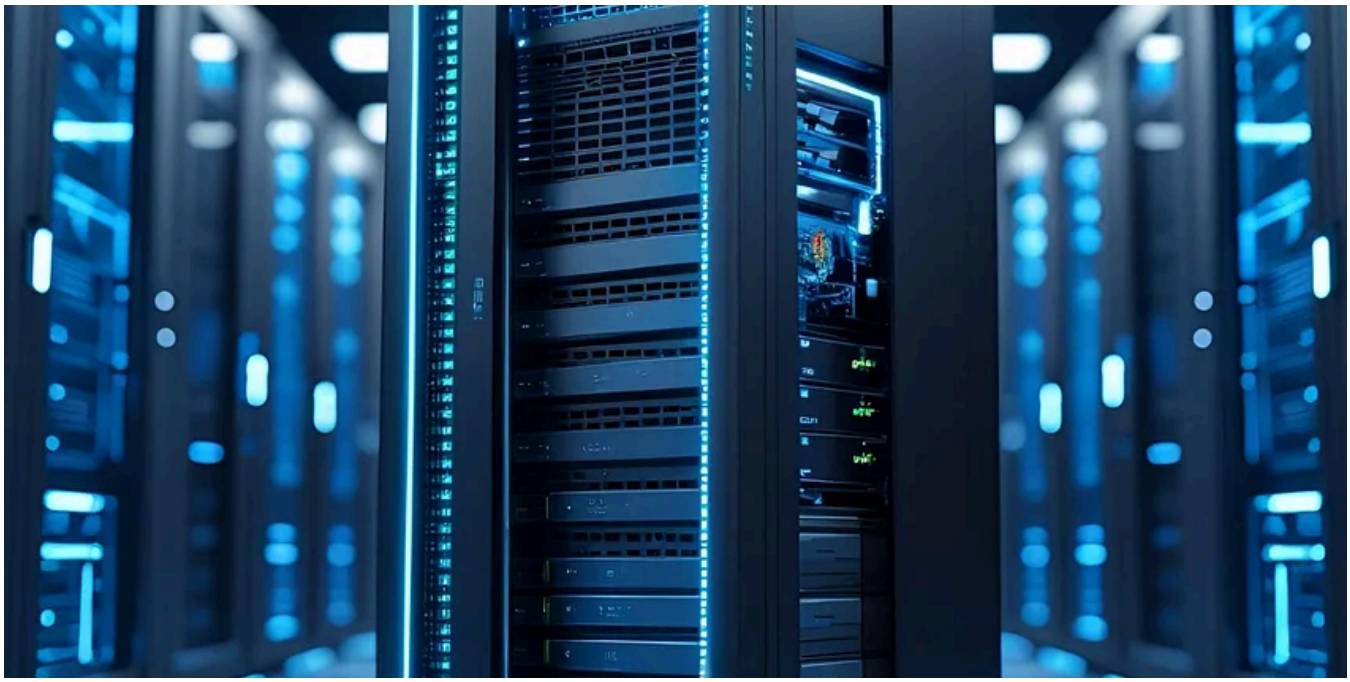

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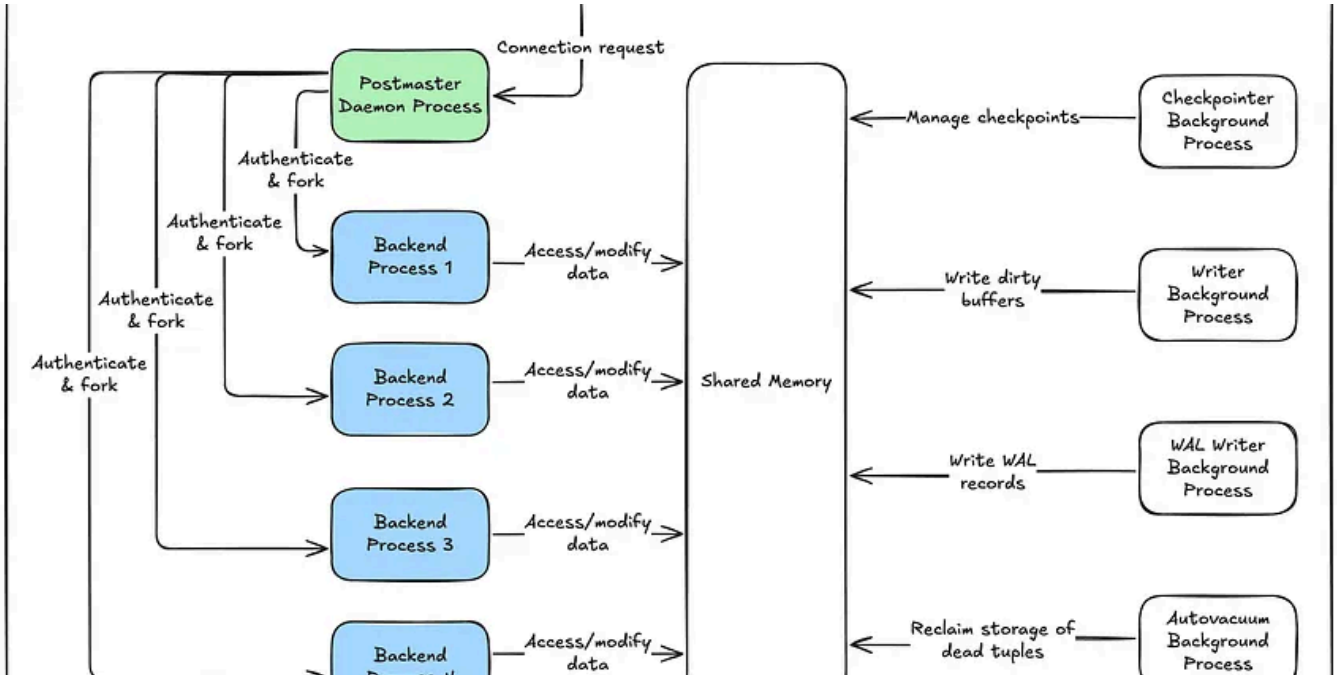

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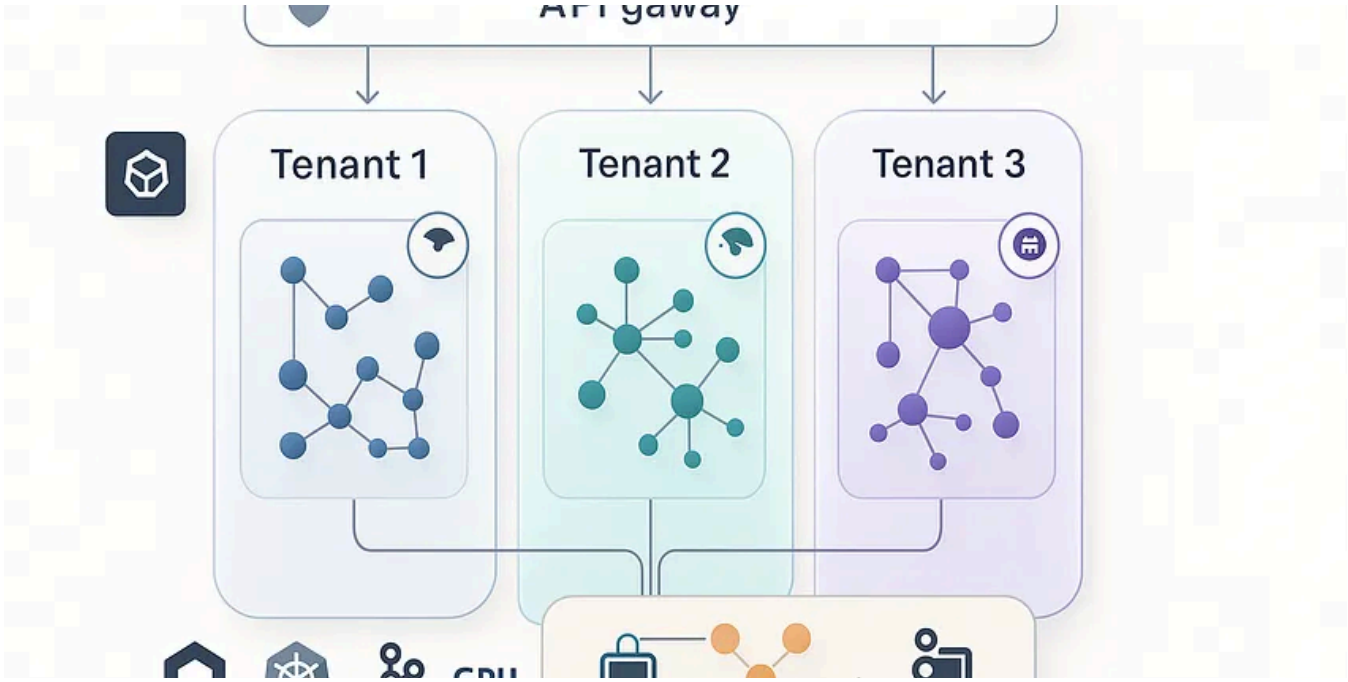

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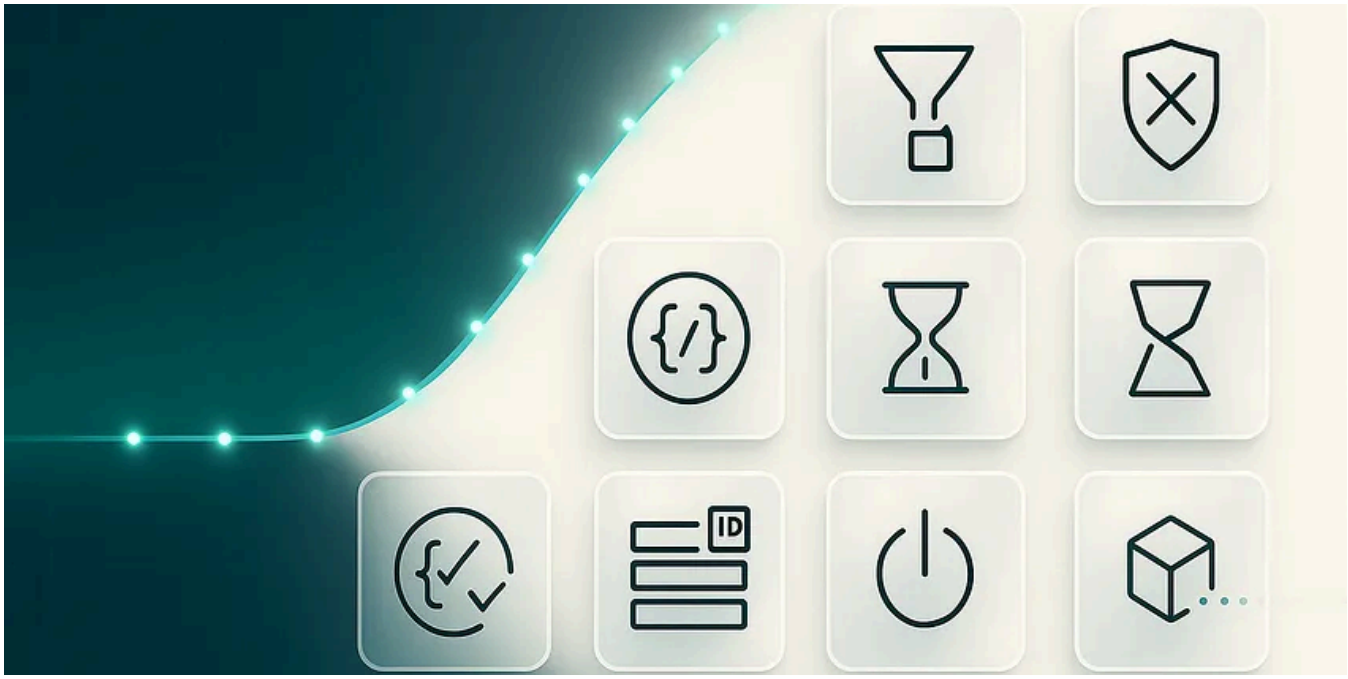

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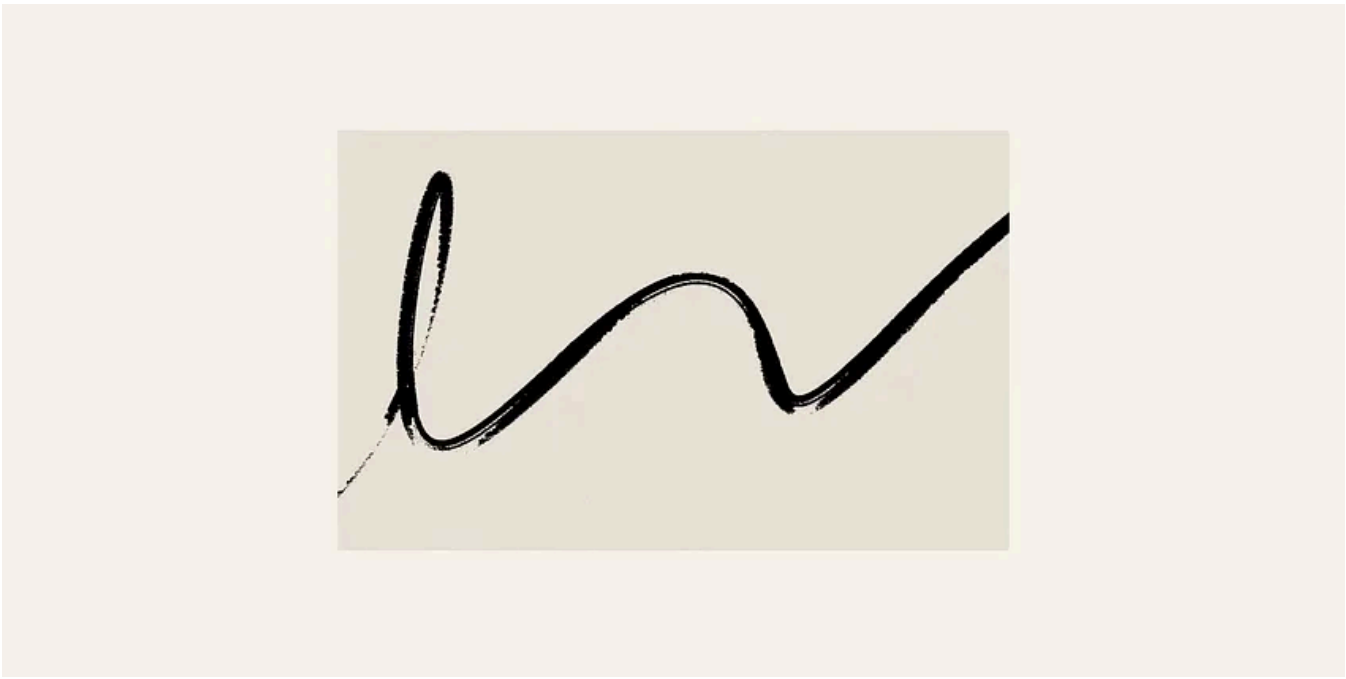

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