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NOSQL BEST PRACTICES

FOR POSTGRESQL

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Introduction

Less benchmarks

More opinionated best practices

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Introduction

Application developers

DBAs

Extension developers

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Application developers

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When jsonb?

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When jsonb?

➔ You have a distinct flexible model

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When jsonb?

- ➔ You have a distinct flexible model
- ➔ You need to work with data provided in document oriented format

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When jsonb?

- ➔ You have a distinct flexible model
- ➔ You need to work with data provided in document oriented format
- ➔ Workaround for technical issues (large number of tables or expensive alignment)

When not jsonb?

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When not jsonb?

➔ Flexibility ”just in case”

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When not jsonb?

- ➔ Flexibility ”just in case”
- ➔ Reluctance to create a migration

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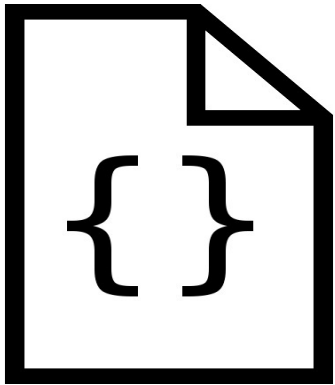
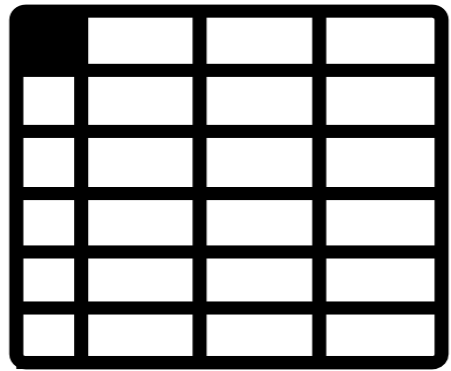
When not jsonb?

- ➔ Flexibility ”just in case”
- ➔ Reluctance to create a migration
- ➔ Use jsonb column as a ”garbage can”

Jsonb -> Relation





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When to move from jsonb to relation?

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When to move from jsonb to relation?

➔ Queries rely significantly in information about internal structure of documents

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When to move from jsonb to relation?

- ➔ Queries rely significantly in information about internal structure of documents
- ➔ There are too many constraints for documents

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When to move from jsonb to relation?

- ➔ Queries rely significantly in information about internal structure of documents
- ➔ There are too many constraints for documents
- ➔ Some parts of document are used much more frequently than other

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```
SELECT id, created FROM some_table
WHERE

(data->>'name' = :a
AND (data @> ('{"items":[{"id":"'||:b||'"}]}'))
AND (data @> ('{"items":[{"elems":[{"name":"'||:c||'"}]}]}'))
AND (data @> ('{"items":[{"elems":[{"id":"'||:d||'"}]}]}'))
AND (data @> ('{"items":[{"name":"'||:e||'"}]}'))

ORDER BY created ASC, id ASC;
```


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Complicated conditions

- ➔ jsquery
- ➔ SQL/JSON

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Complicated conditions

```
SELECT id, created FROM some_table
WHERE

    data @@ 'items.#(id = '||:a||')'
    AND data @@ 'items.#.elems.#(name = '||:b||')'
    AND data @@ 'items.#.elems.#(id = '||:c||')'
    AND data @@ 'items.#(name = '||:d||')'

ORDER BY created ASC, id ASC;
```


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Complicated conditions

```
SELECT id, created FROM some_table
WHERE

    data @~ '$.items[*] ? (@id = '||:a||')'
    AND data @~ '$.items[*].elems[*] ? (@name = '||:b||')'
    AND data @~ '$.items[*].elems[*] ? (@id = '||:c||')'
    AND data @~ '$.items[*](@name = '||:d||')'

ORDER BY created ASC, id ASC;
```


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Complicated select

```
SELECT
    st.data #>> '{item_a, another_item}' AS item_a,
    st.data #>> '{item_c}'               AS item_c,
    jsonb_array_elements(
        data #> '{item_b, subitem_a, subitem_b}'
    ) ->> 'some_key'                     AS item_e

    FROM some_table st LEFT JOIN another_table at
    ON (st.data #> '{item_b, key_a, key_b}') @>
        jsonb_build_array(jsonb_build_object(
            'key', 'some_key_name',
            'value', at.data #>> '{item_b, another_item}'
        ));
```


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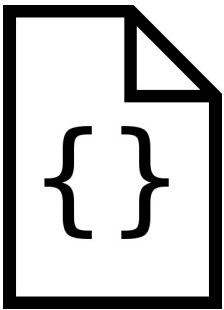
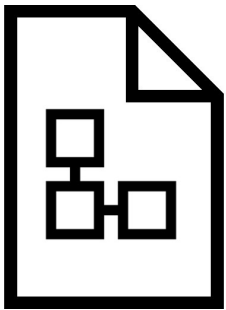
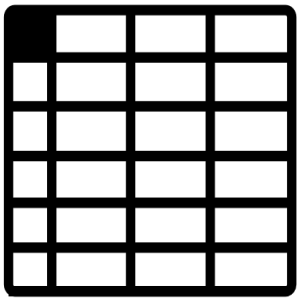
Jsonb -> Relation







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Constraints

- ➔ Simple checks for value, type or size
- ➔ More convenient checks with jsquery
- ➔ Json schema

Constraints

```
CREATE TABLE test (
    data jsonb,
    CHECK (jsonb_typeof(data->'key') = 'array')
);
CREATE TABLE test (
    data jsonb,
    CHECK (data @@ 'key IS ARRAY OR key IS OBJECT')
);
CREATE TABLE test (
    data jsonb,
    CHECK (validate_json_schema('{"key": "array"}', data))
);
```


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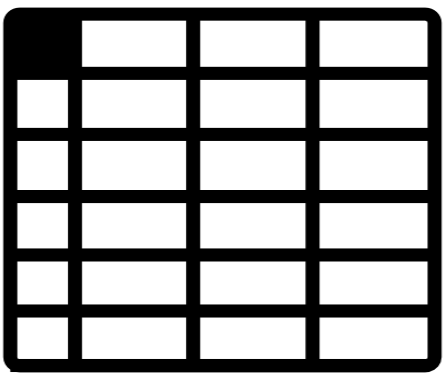
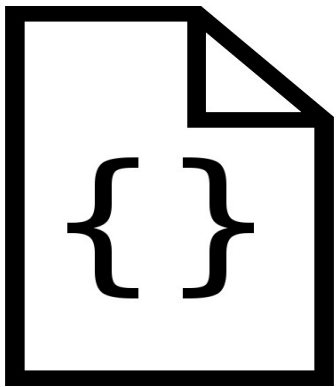
Relation -> Jsonb





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```
SELECT jsonb_agg(query) FROM (
    SELECT id, data
    FROM jsonb_table
) query;
```


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Seamless interaction between json and relation

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```
[{
    "items": [
        {"id": 1, "value": "aaa"},
        {"id": 2, "value": "bbb"}
    ]
}, {
    "items": [
        {"id": 3, "value": "aaa"},
        {"id": 4, "value": "bbb"}
    ]
}]
```


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```
WITH items AS (
    SELECT jsonb_array_elements(data->'items')
    AS item FROM test
)
SELECT * FROM items
WHERE item->>'value' = 'aaa';
```

```
item
---------------------------
 {"id": 1, "value": "aaa"}
 {"id": 3, "value": "aaa"}
(2 rows)
```


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```
WITH items AS (
    SELECT jsonb_array_elements(data->'items')
    AS item FROM test
)
SELECT * FROM items
WHERE item->>'value' = 'aaa';
```

```
item
---------------------------
 {"id": 1, "value": "aaa"}
 {"id": 3, "value": "aaa"}
(2 rows)
```


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```
{
    "items": {
        "item1": {"status": true},
        "item2": {"status": true},
        "item3": {"status": false}
    }
}
```


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```
WITH items AS (
    SELECT jsonb_each(data->'items')
    AS item FROM test
)
SELECT (item).key FROM items
WHERE (item).value->>'status' = 'true';
```

```
 key
-------
 item1
 item2
(2 rows)
```


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```
WITH items AS (
    SELECT jsonb_each(data->'items')
    AS item FROM test
)
SELECT (item).key FROM items
WHERE (item).value->>'status' = 'true';
```

```
 key
-------
 item1
 item2
(2 rows)
```


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Multiple jsonb columns

- ➔ Keep at the end for readability
- ➔ tuple_deform (PG11, JIT compilation)

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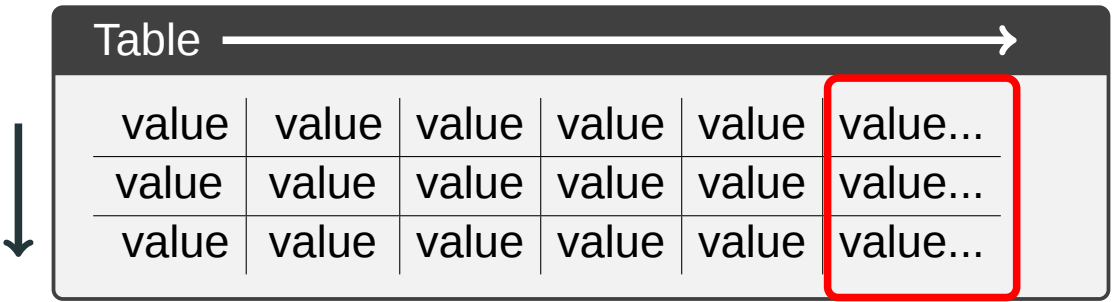
Multiple jsonb columns



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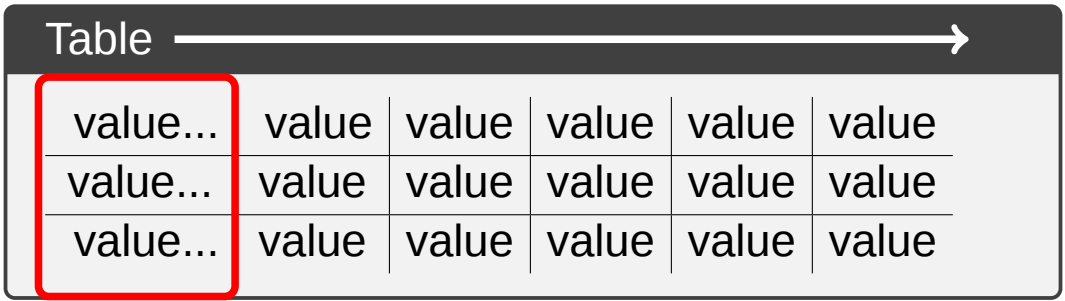
Multiple jsonb columns



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Document slice: in the DB or on the app?

- ➔ Amount of data passed from DB to application
- ➔ Performance hit in some cases (multiple detoasting)

```
select data->'key1'->'key2' from table;

select data->'key1', data->'key2' from table;
```


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```
select data->`key1`->`key2` from table;

select data->'key1', data->'key2' from table;
```


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```
select data->'key1'->'key2' from table;

select data->`key1`, data->`key2` from table;
```


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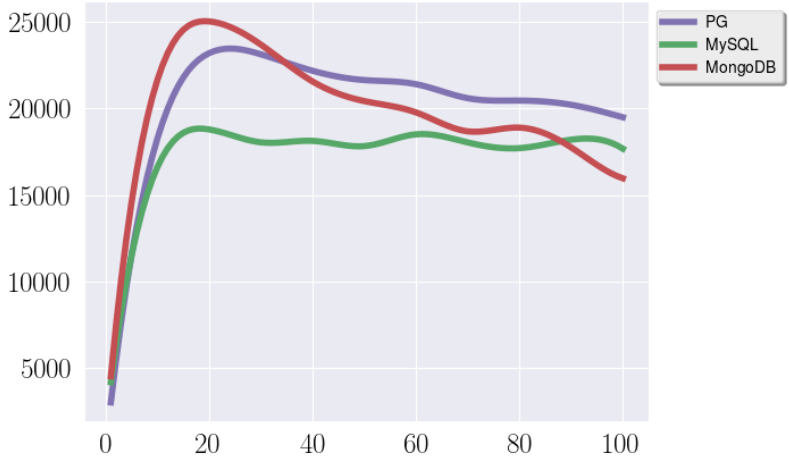
Throughput (ops/sec)



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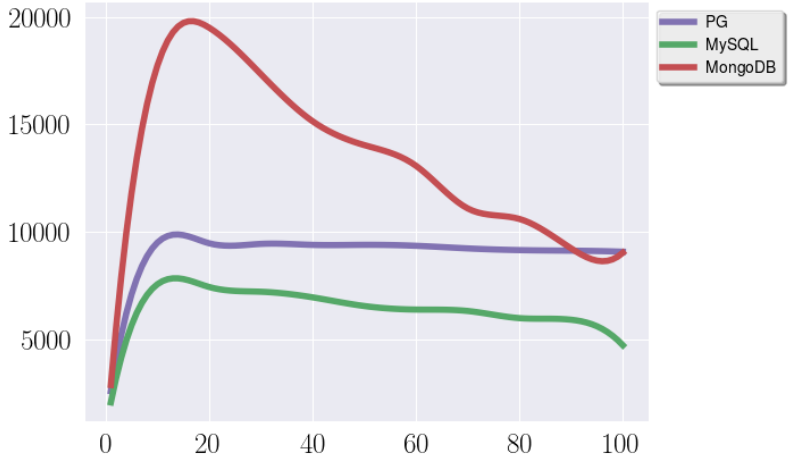
Throughput (ops/sec)



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- ➔ Plain Json
- ➔ Binary Jsonb
- ➔ Relation

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Insert workload

Throughput (ops/sec)

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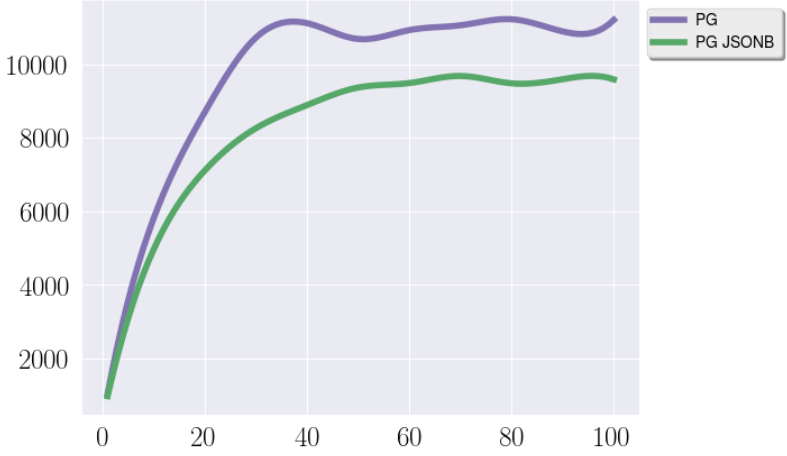
Throughput (ops/sec)



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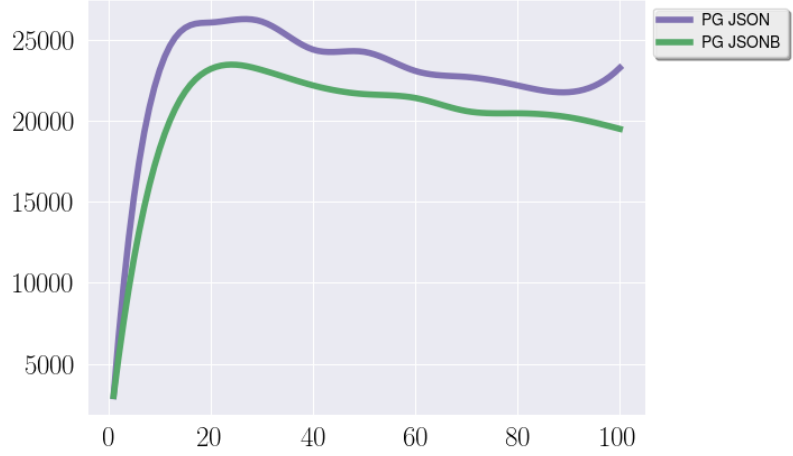
Read workload

Throughput (ops/sec)



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Throughput (ops/sec)
25000
20000
15000
10000
5000
0
20
40
60
80
100
PG
PG JSONB

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Jsonb array vs regular array

- ➔ Store elements of different type?
  Not really a ”single model” idea.
- ➔ Syntax is less natural (this may change)
- ➔ Updates are slower
- ➔ Arrays are 1-based, Jsonb 0-based

```sql
SELECT array[0] FROM some_table;
SELECT jsonb->0 FROM some_table;
-- WIP
SELECT jsonb[0] FROM some_table;

UPDATE some_table SET array[0] = 'new_value';
UPDATE some_table
SET jsonb = jsonb_set(jsonb, '{0}', 'new_value');
-- WIP
UPDATE some_table SET jsonb[0] 'new_value';
```


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Jsonb NULL != SQL NULL

```
SELECT jsonb_set(data, '{key}', NULL);
 jsonb_set
-----------
 NULL
(1 row)

SELECT jsonb_set(data, '{key}', 'null');
 jsonb_set
-----------
 {"key": null}
(1 row)
```


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Some useful extensions

- ➔ jsquery
- ➔ postgres-json-schema
- ➔ is_jsonb_valid
- ➔ zson (jsonbc, custom compression methods WIP)
- ➔ jsonb_explorer

Types, please

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DBAs

Limitations

Size 256 MB

Depth - max_stack_depth

Stack depth is different for create & update

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Indexing support

- ➔ GIN index (jsonb_ops, jsonb_path_ops)
- ➔ Functional BTree index
- ➔ jsquery strategies for GIN
- ➔ Partial indexes WIP

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Place for ID

- ➔ Inside a document
- ➔ As as separate column

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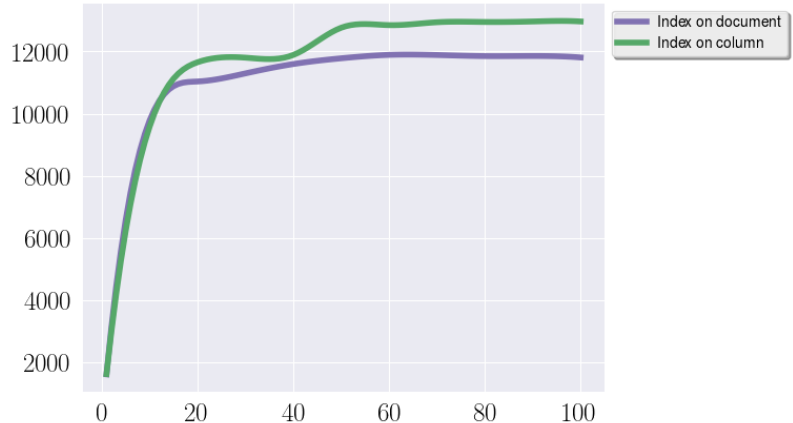
PG, Throughput (ops/sec)



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Place for ID

PostgreSQL 11 have HOT updates for some expression indexes, which will eliminate this problem.

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Statistics

- ➔ There is no proper selectivity estimation for jsonb
- ➔ Optimizer can give wrong estimations for GIN and complex queries
- ➔ Functional indexes

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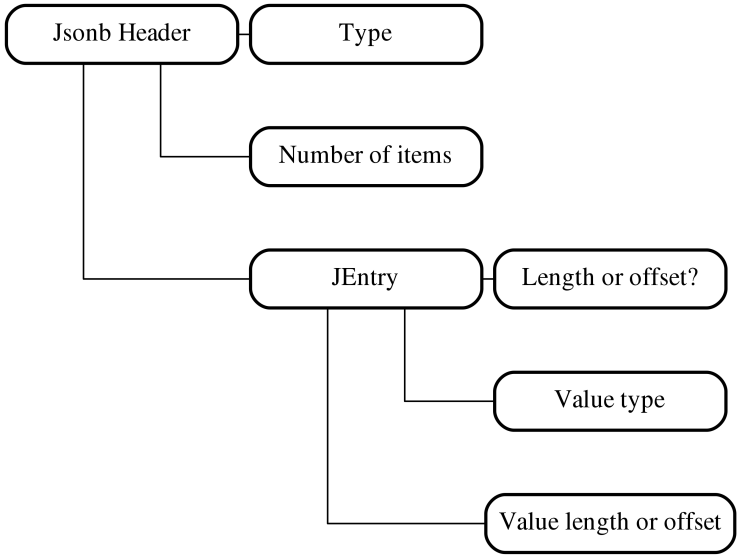
How much to write?

Jsonb vs Json



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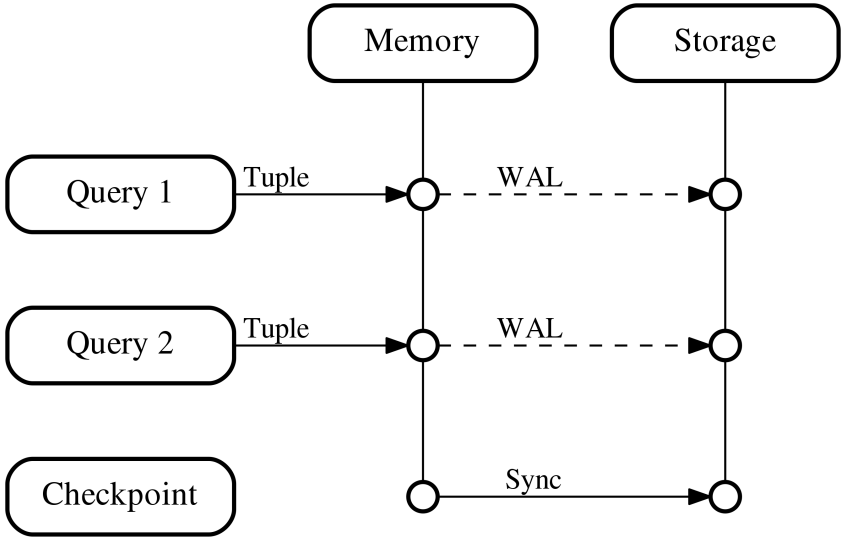
Memory
Storage
Query 1
Tuple
WAL
Query 2
Tuple
WAL
Checkpoint
Sync

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How much to write?

- ➔ Every update leads to update of an entire document (but it’s ok)
- ➔ WAL can have a full document or just a diff
- ➔ Old and new tuples fit into the same page - diff
- ➔ Old and new tuples fit into the same page - full
- ➔ If logical decoding is enabled - full

How much to write?

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How much to write?

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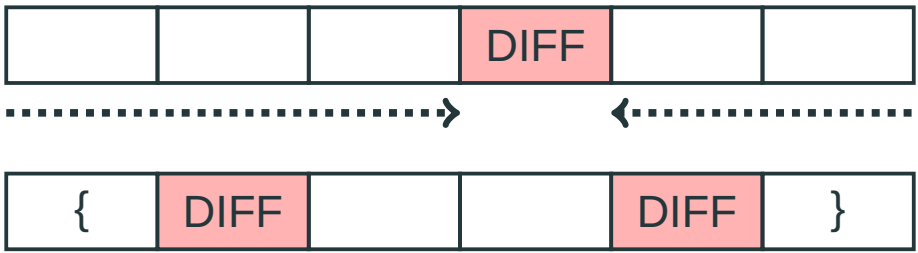
How much to write?



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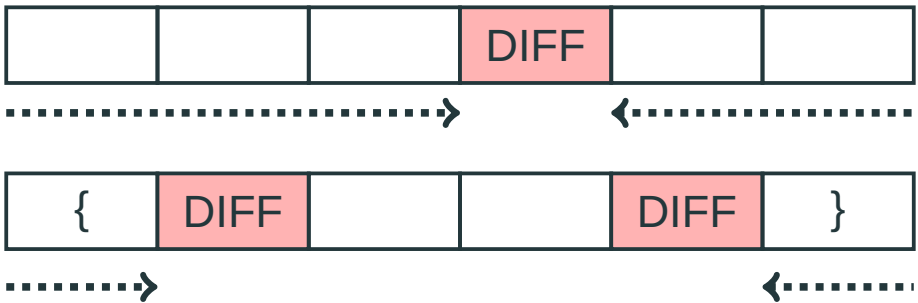
How much to write?



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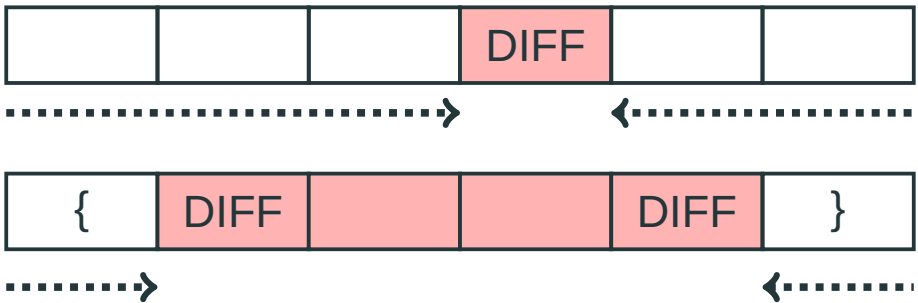
How much to write?



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Huge documents

- ➔ TOAST has significant overhead (assemble, locks)
- ➔ Other than that linear degradation

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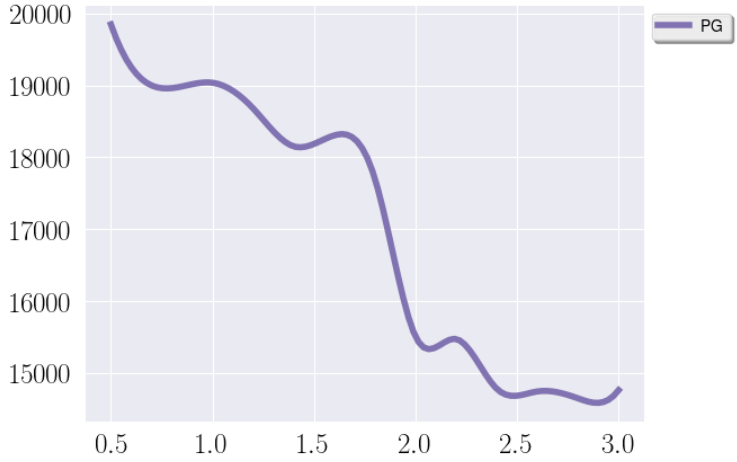
Throughput, 40 clients



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Alignment

Variable-length portion is aligned to a 4-byte

```
insert into test
values('{"a": "aa", "b": 1}');
```

```
abaa\x20\x00\x00\x00\x00\x80\x01\x00
```

```
insert into test
values('{"a": 1, "b": "aa"}');
```

```
\x00\x00ab\x00\x00\x20\x00\x00\x00\x00\x80\x01\x00aa
```


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Extensions

Why write an extension?

- ➔ Implement some convenient functionality (e.g. jsonb intersection)
- ➔ Create function optimized for your domain model

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Why write an extension?

findJsonbValueFromContainer -> binary search

_id in a fixed position?

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- ➔ Raw Jsonb container when search for an element
- ➔ Iterate through JsonbValue when update

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Reuse infrastructure

- ➔ findJsonbValueFromContainer
- ➔ JsonbIterator
- ➔ addToParseState
- ➔ worker functions

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Random tips

- ➔ Clone iterator
- ➔ String are not null-terminated

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Questions?

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