zalando

NOSQL
BEST PRACTICES

FOR POSTGRESQL

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29-03-2018

Introduction

Less benchmarks

More opinionated best practices

Introduction

Application developers

DBAs

Extension developers

Application developers

When jsonb?

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- ➔ You need to work with data provided in document oriented format

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- ➔ 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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➔ Flexibility ”just in case”

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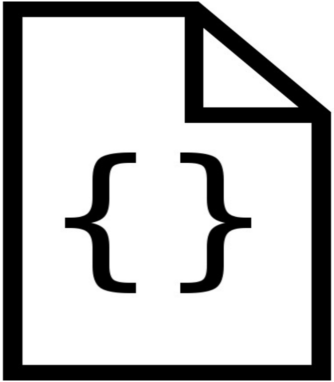
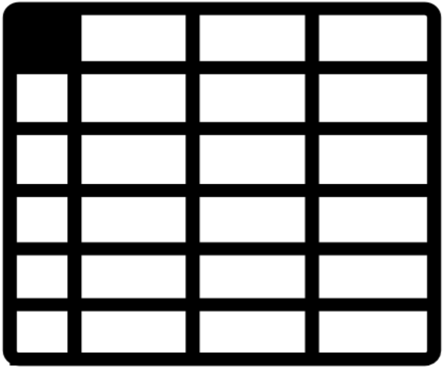
- ➔ Reluctance to create a migration

When not jsonb?

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

Jsonb -> Relation





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
- ➔ There are too many constraints for documents
- ➔ Some parts of document are used much more frequently than other

```
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;
```

Complicated conditions

- ➔ jsquery
- ➔ SQL/JSON

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;
```

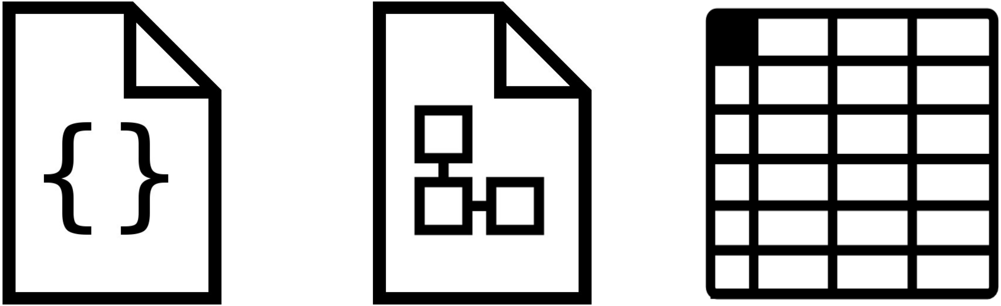
Complicated conditions

```
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;
```

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}'
        ));
```

Jsonb -> Relation



Constraints

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

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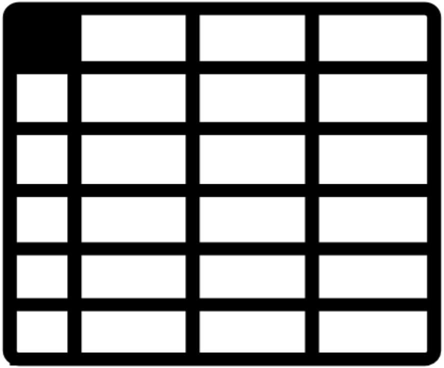
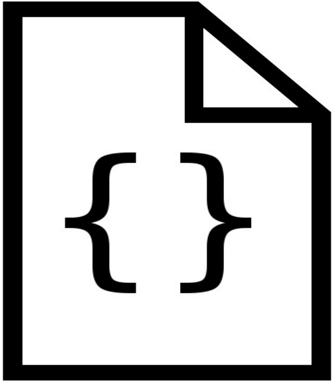
Constraints

```
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))
);
```

Relation -> Jsonb





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

Seamless interaction between json and relation

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

```
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)
```

```
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)
```

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

```
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)
```

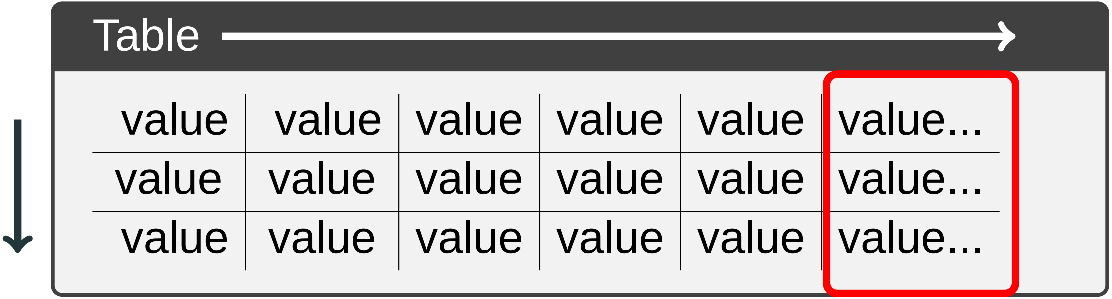
```
WITH items AS (
    SELECT jsonb_each(data->'items')
    AS item FROM test
)
SELECT (item).key FROM items
WHERE (item).value->>'status' = 'true';
```

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

Multiple jsonb columns

- ➔ Keep at the end for readability
- ➔ tuple_deform

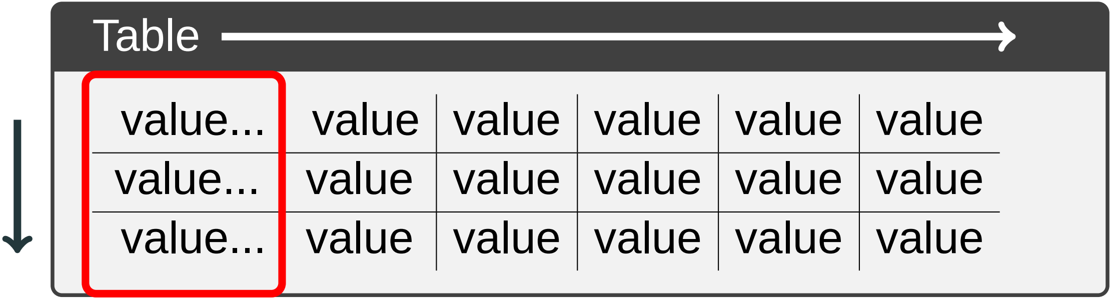
Multiple jsonb columns



Table

value	value	value	value	value	value...
value	value	value	value	value	value...
value	value	value	value	value	value...

Multiple jsonb columns



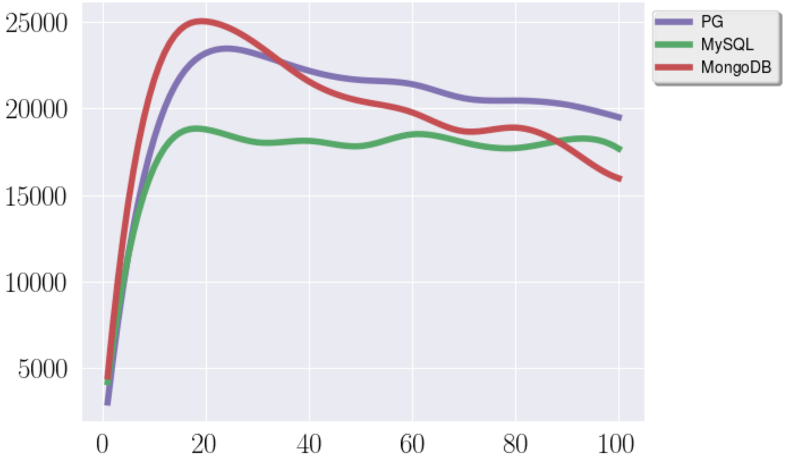
Table

value...	value	value	value	value	value
value...	value	value	value	value	value
value...	value	value	value	value	value

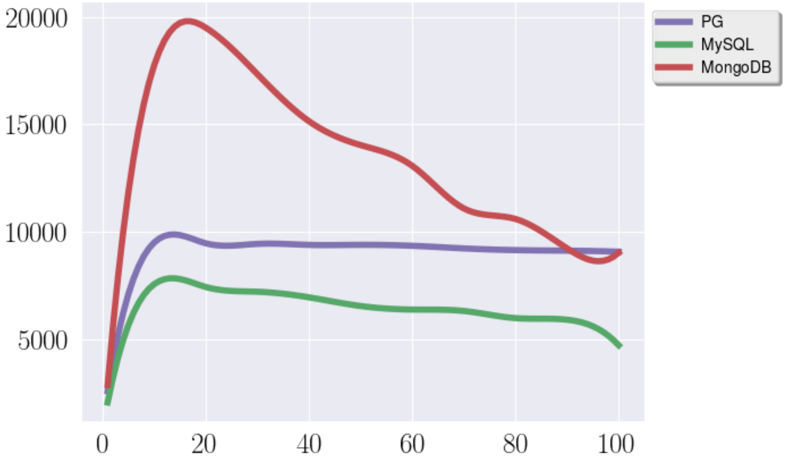
Document slice: in the DB or on the app?

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

Throughput (ops/sec)

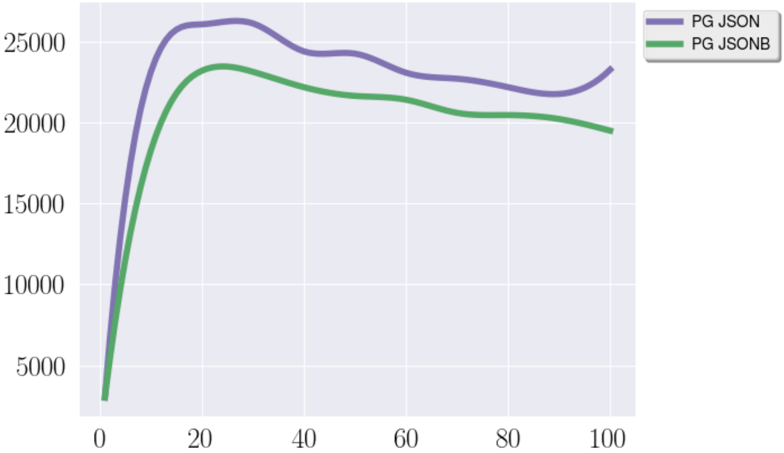


Throughput (ops/sec)

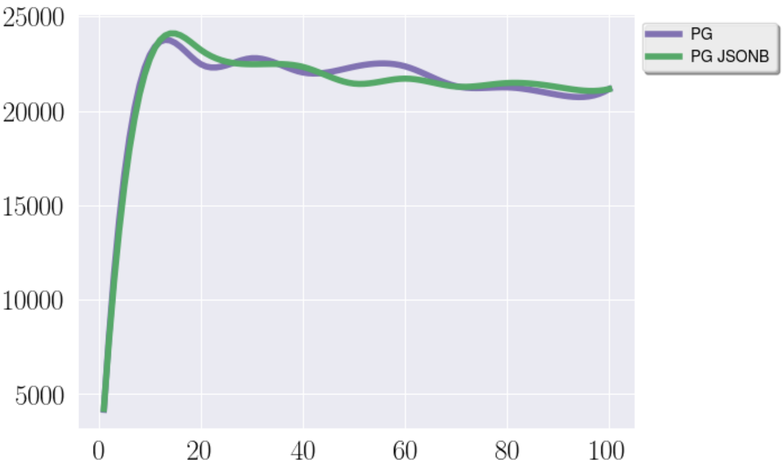


- ➔ Plain Json
- ➔ Binary Jsonb
- ➔ Relation

Throughput (ops/sec)



Throughput (ops/sec)



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

```
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';
```

Some useful extensions

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

Types, please

@kickass-peanut

DBAs

Limitations

Size 256 MB

Depth - max_stack_depth

Stack depth is different for create & update

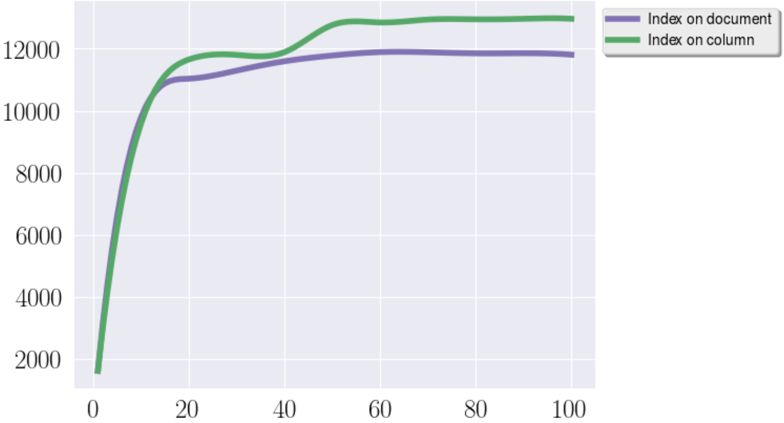
Indexing support

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

Place for ID

- ➔ Inside a document
- ➔ As as separate column

PG, Throughput (ops/sec)



Place for ID

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

Statistics

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

How much to write?

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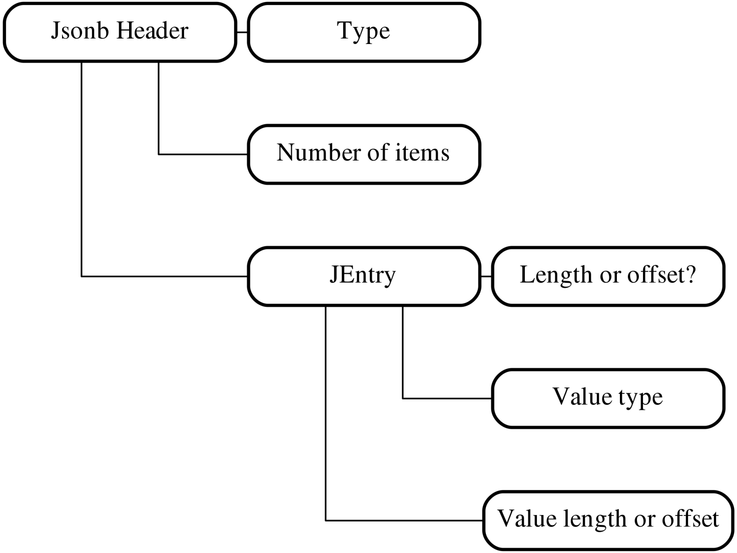
Jsonb vs Json



Jsonb Header

Type

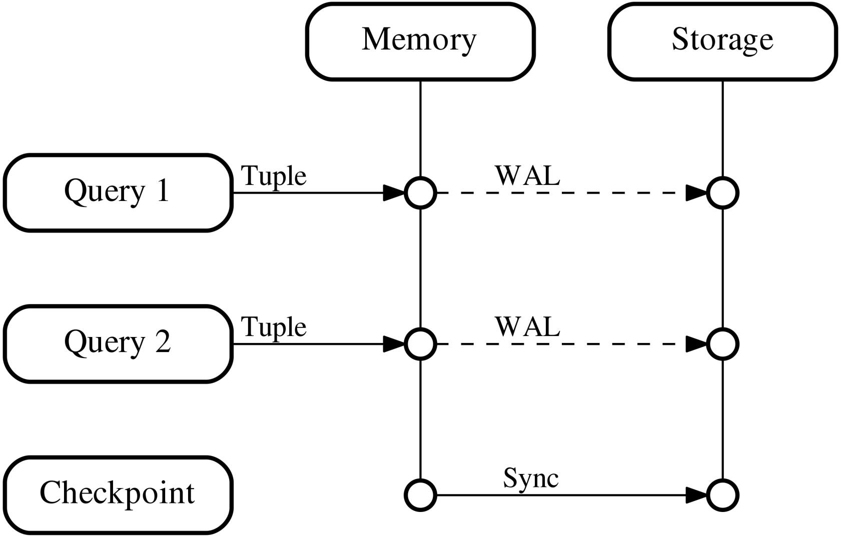
Number of items

JEntry

Length or offset?

Value type

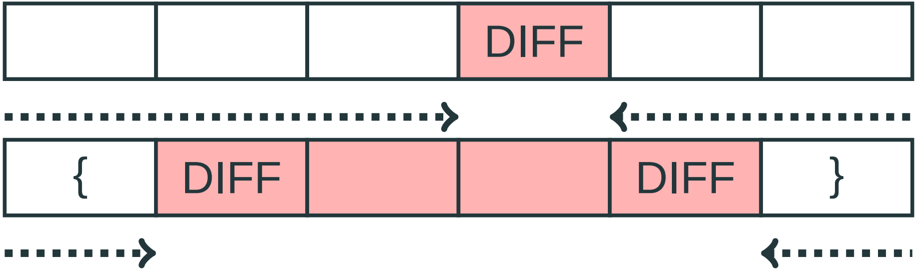
Value length or offset


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

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

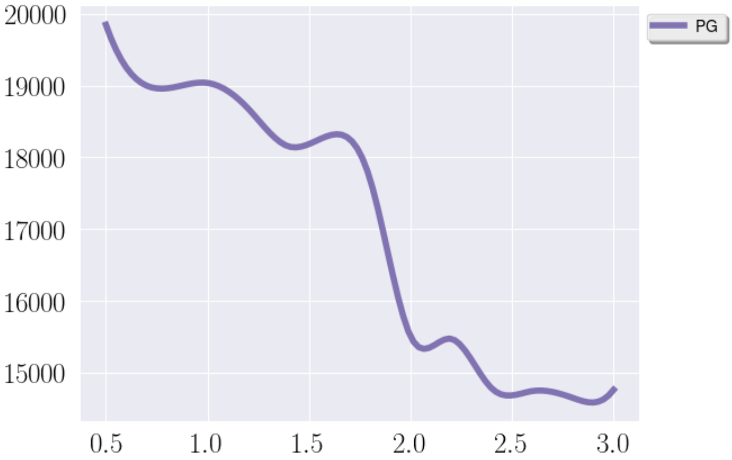
How much to write?



Huge documents

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

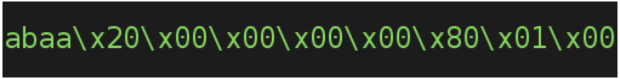
Throughput, 40 clients



Alignment

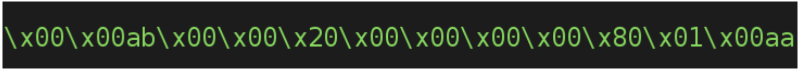
Variable-length portion is aligned to a 4-byte

```
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
```

Extensions

Why to write an extension?

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

Why to write an extension?

findJsonbValueFromContainer -> binary search

_id in a fixed position?

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

Reuse infrastructure

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

Random tips

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

Questions?

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