



# NOSQL BEST PRACTICES

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FOR POSTGRESQL



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# Introduction

Less benchmarks

More opinionated best practices

# Introduction

Application developers

DBAs

Extension developers

# Application developers

# When jsonb?

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→ You have a distinct flexible model

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- You have a distinct flexible model
- 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"

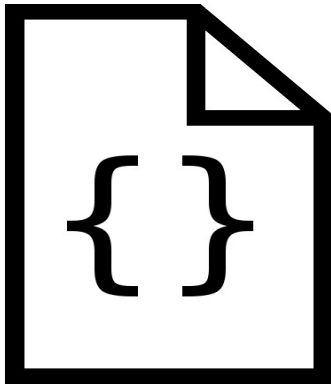
## When not jsonb?

- Flexibility "just in case"
- 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

- jquery
- 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;
```

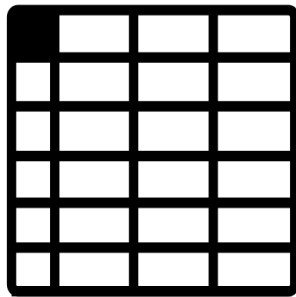
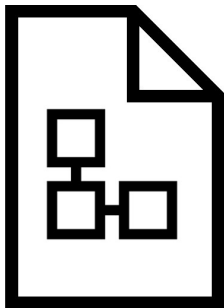
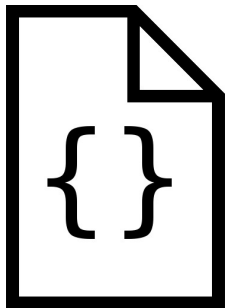
# Complicated select

## 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 jquery
- Json schema



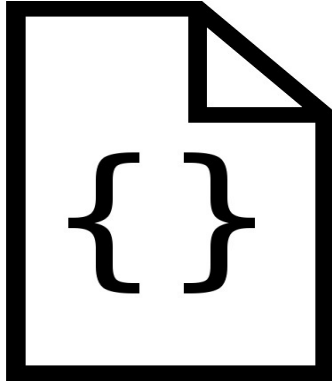
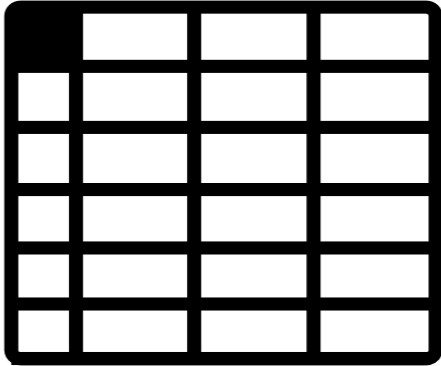
# Constraints

```
CREATE TABLE test (  
  data jsonb,  
  CHECK (jsonb_typeof(data->'key') = 'array')  
);
```

```
CREATE TABLE test (  
  data jsonb,  
  CHECK (data @> 'key' IS ARRAY OR data @> '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 rela- tion

```
[{
  "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 (PG11, JIT compilation)

## 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)

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

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

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

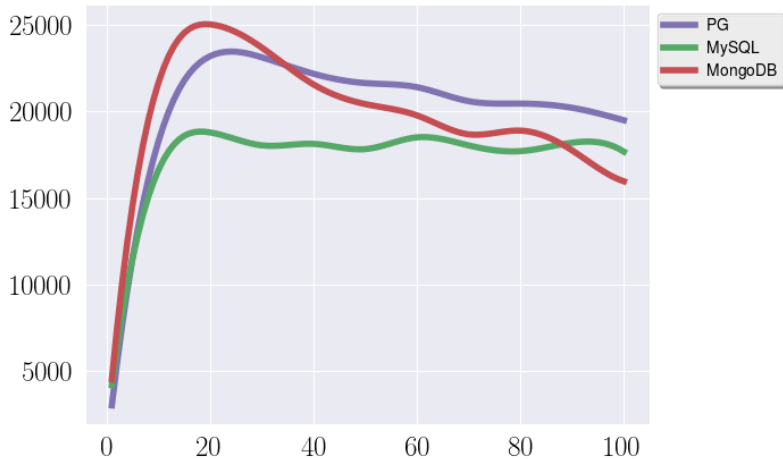
```
select data->'key1', data->'key2' from table;
```



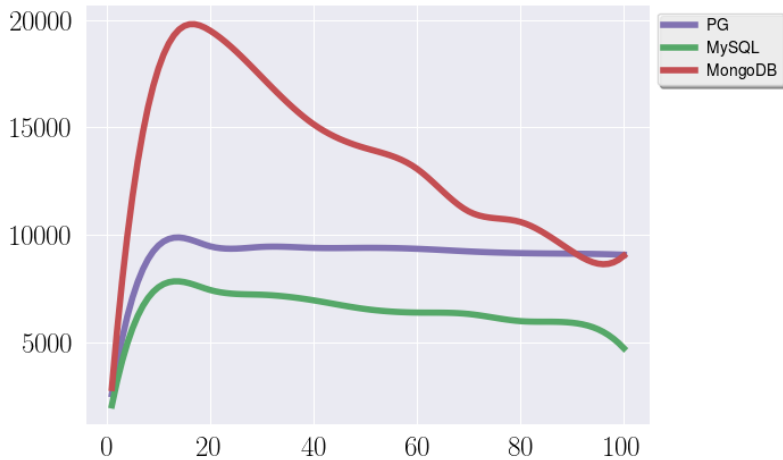
```
select data->'key1'->'key2' from table;
```

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

# Throughput (ops/sec)



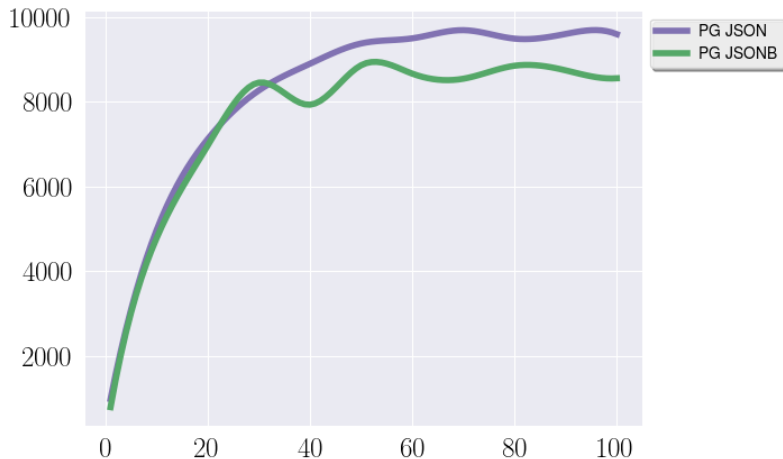
# Throughput (ops/sec)



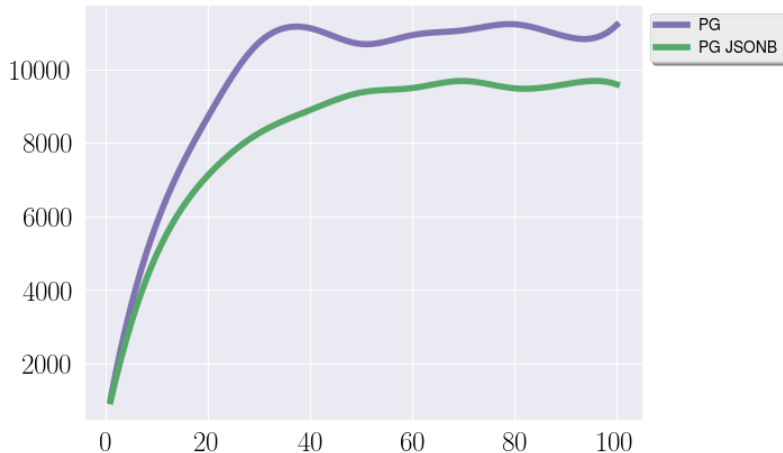
- Plain Json
- Binary Jsonb
- Relation

# Insert workload

# Throughput (ops/sec)



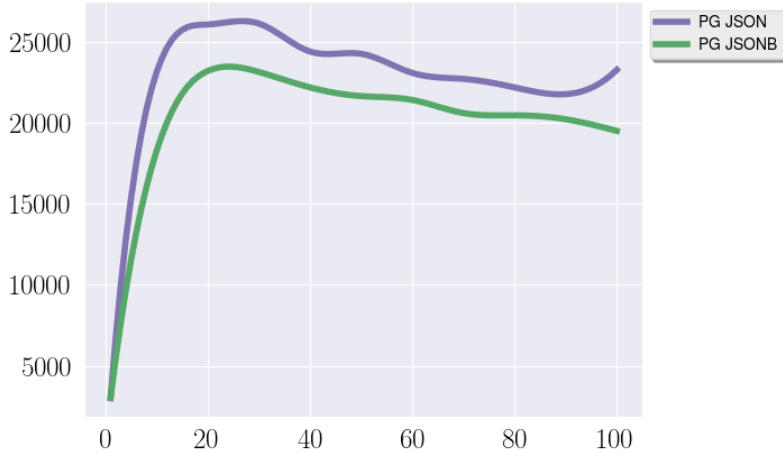
# Throughput (ops/sec)



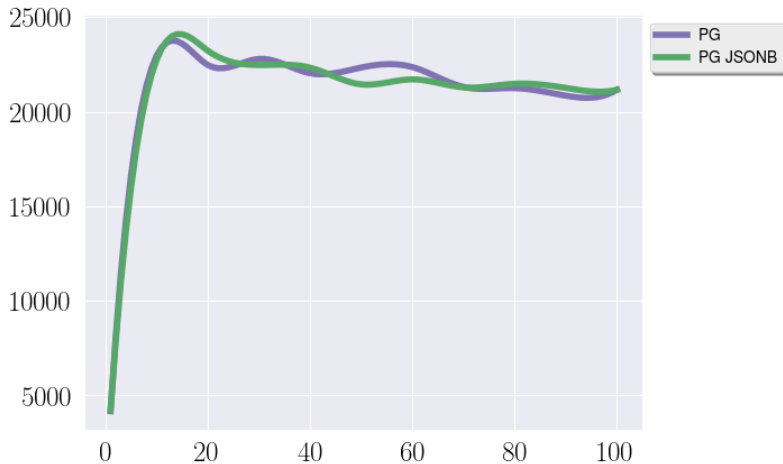
# Read workload



# 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';
```

## 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)
```

## Some useful extensions

- jsquery
- postgres-json-schema
- is\_jsonb\_valid
- zson (jsonbc, custom compression methods WIP)
- jsonb\_explorer

**Types, please**





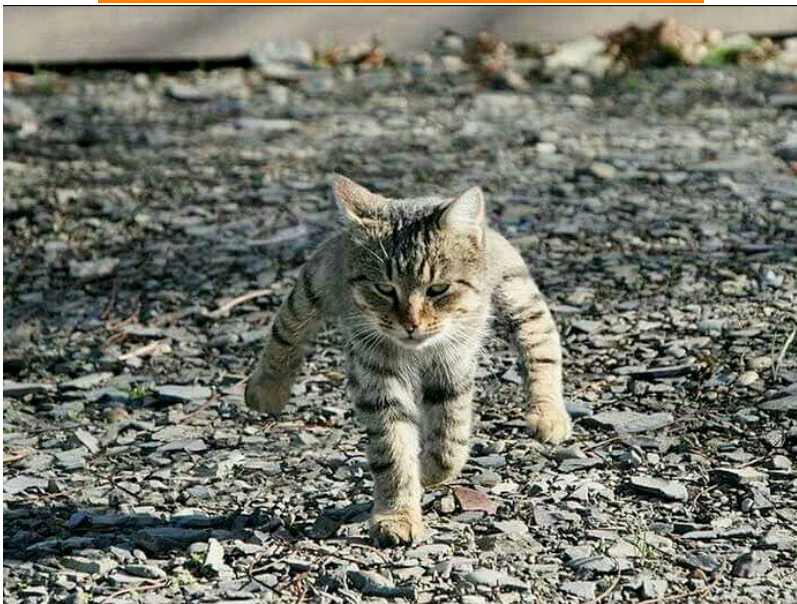
# DBAs

## Limitations

Size 256 MB

Depth - max\_stack\_depth

Stack depth is different for create & update



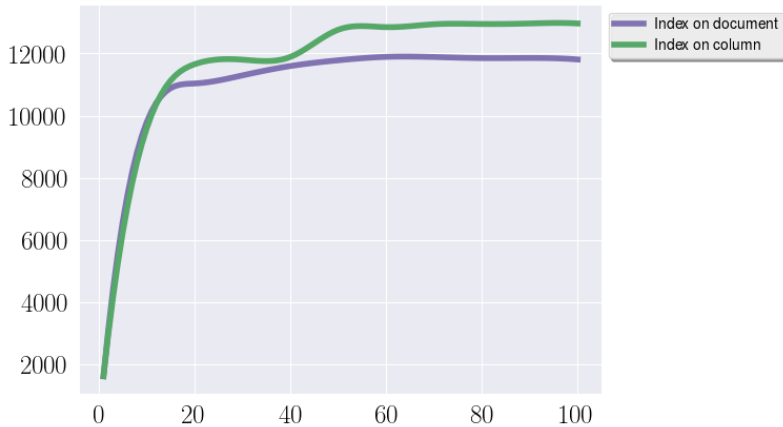
## Indexing support

- GIN index (jsonb\_ops, jsonb\_path\_ops)
- Functional BTree index
- jsquery strategies for GIN
- Partial indexes WIP

## Place for ID

- Inside a document
- As a separate column

## PG, Throughput (ops/sec)



## Place for ID

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

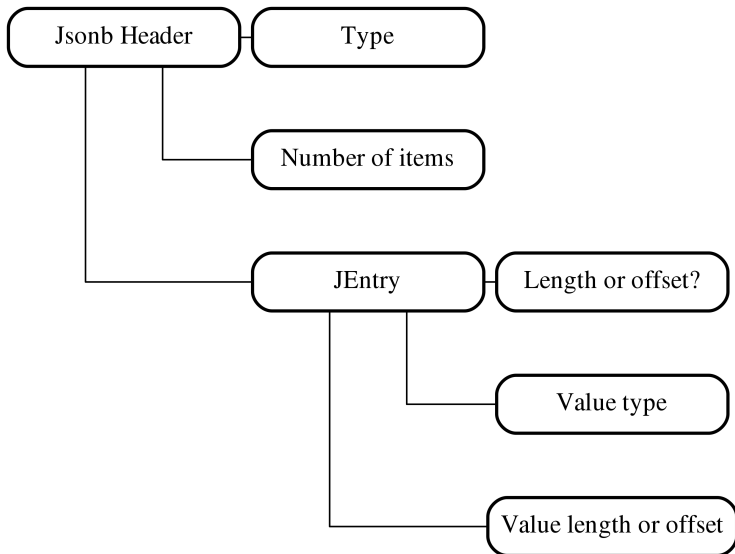
## Statistics

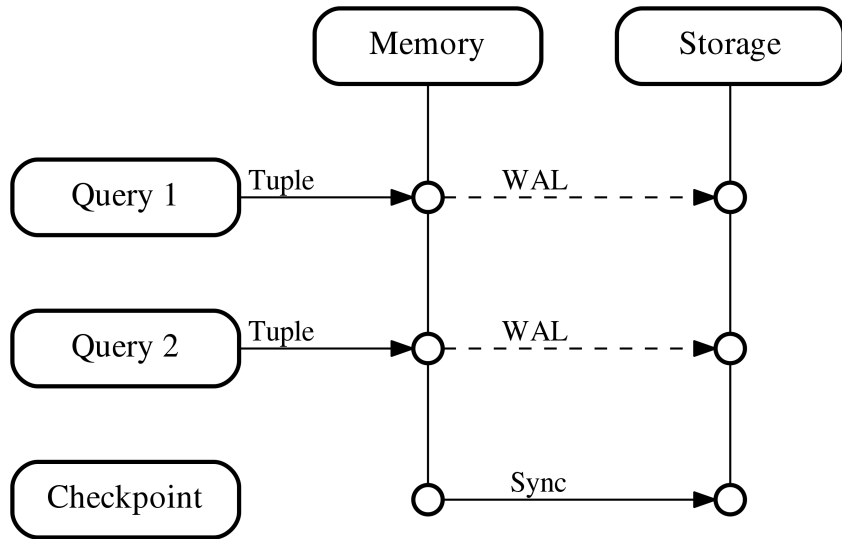
- There is no proper selectivity estimation for jsonb
- Optimizer can give wrong estimations for GIN and complex queries
- Functional indexes



# How much to write?

# Jsonb vs Json





## 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

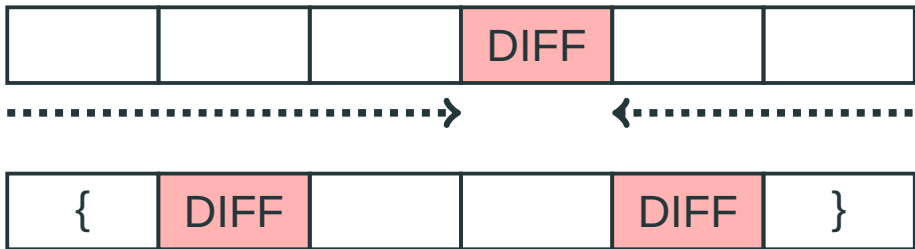
## How much to write?



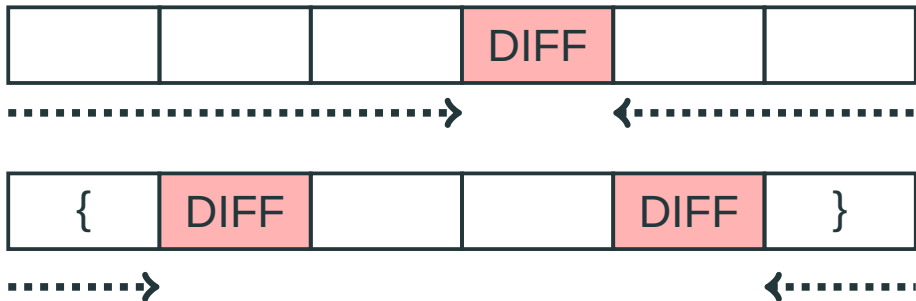
## How much to write?



## How much to write?

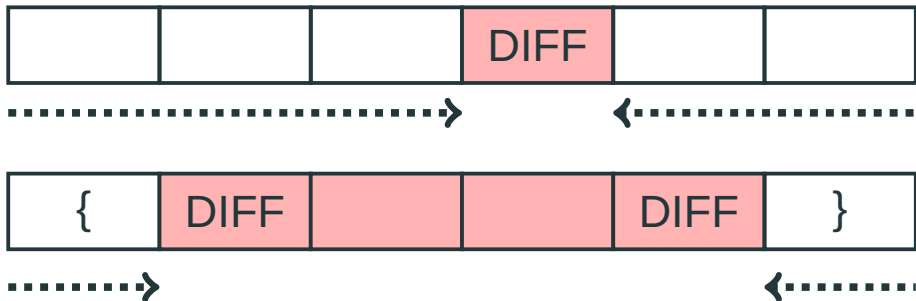


## How much to write?





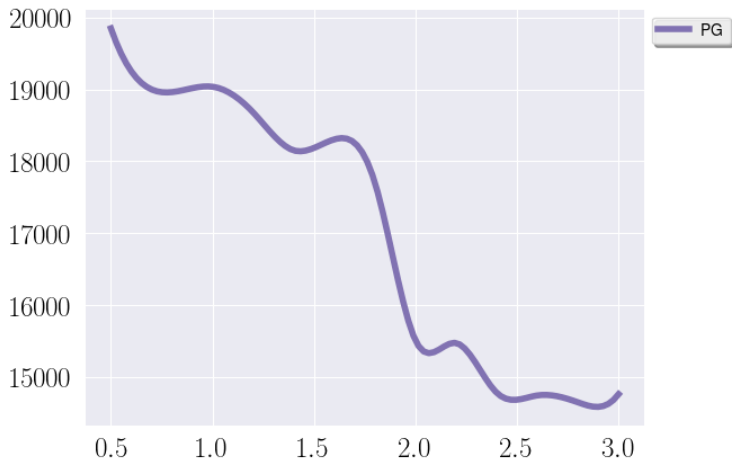
## How much to write?



## 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?

`findJsonValueFromContainer` -> binary search  
\_id in a fixed position?

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



## Reuse infrastructure

- findJsonValueFromContainer
- JsonbIterator
- addToParseState
- worker functions


## Random tips

- Clone iterator
- String are not null-terminated

## Questions?

 [github.com/erthalion](https://github.com/erthalion)

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