zalando

NOSQL INSIDE SQL

STRATEGY AND TACTICS

DMITRY DOLGOV

06-07-2017

Не отвлекайся на всякий вздор

Только Postgres
Только хардкор

- ➔ Jsonb internals and performance-related factors

- Jsonb internals and performance-related factors
- Benchmarks

- ➔ Jsonb internals and performance-related factors
- ➔ Benchmarks
- ➔ How to shoot yourself in the foot

Internals

Performance-related factors

Performance-related factors

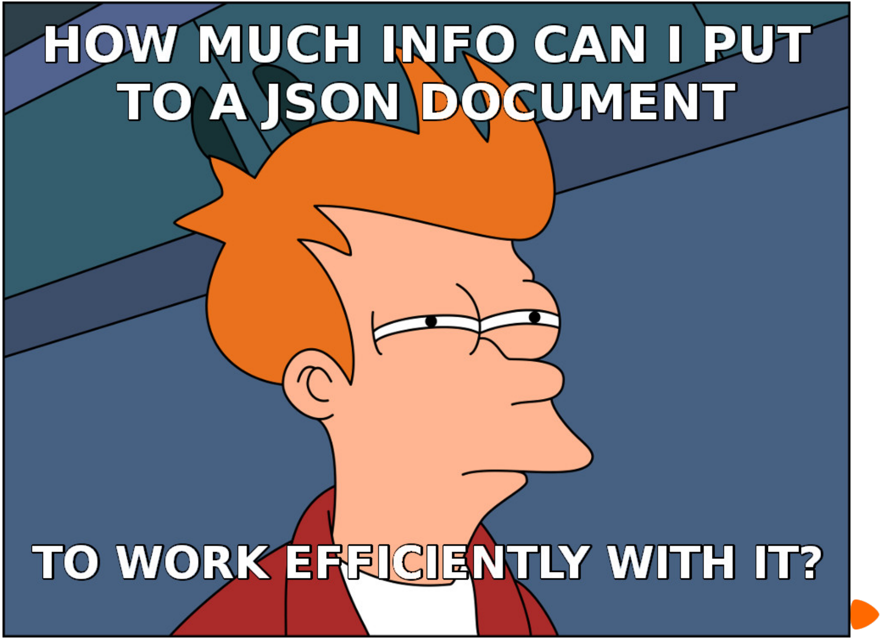
➔ On-disk representation

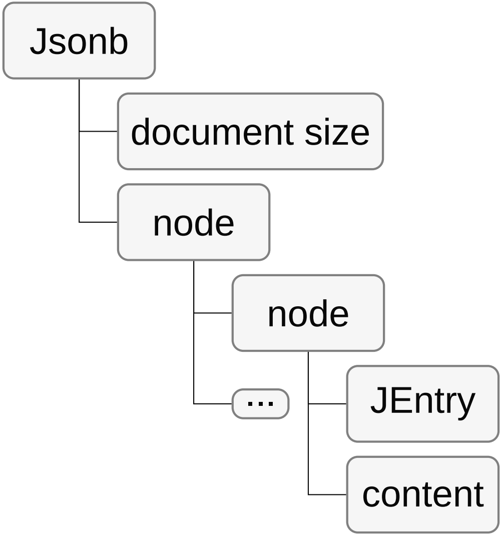
Performance-related factors

- ➔ On-disk representation
- ➔ In-memory representation

Performance-related factors

- ➔ On-disk representation
- ➔ In-memory representation
- ➔ Indexing support


HOW MUCH INFO CAN I PUT TO A JSON DOCUMENT
TO WORK EFFICIENTLY WITH IT?



Jsonb

document size

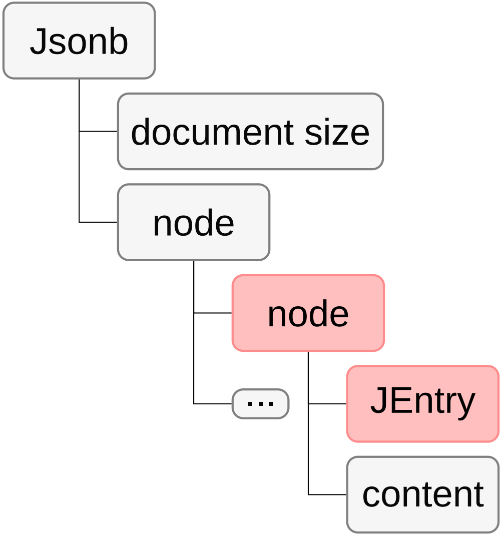
node

node

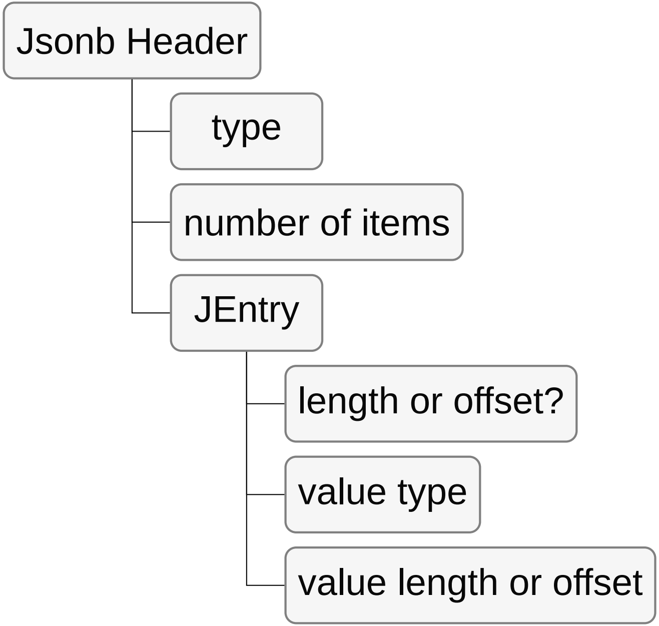
...

JEntry

content



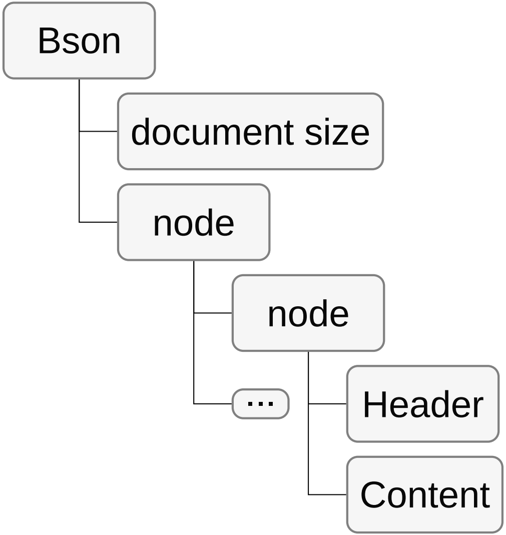
Jsonb
document size
node
node
...
JEntry
content



- Jsonb Header
  - type
  - number of items
  - JEntry
    - length or offset?
    - value type
    - value length or offset

JB_OFFSET_STRIDE

- ➔ JEntry may contains a value lenght or offset
- ➔ Offset = access speed
- ➔ Length = compressibility
- ➔ Every **JB_OFFSET_STRIDE**’th JEntry contains an offset
- ➔ Rest of them contain length



Bson

document size

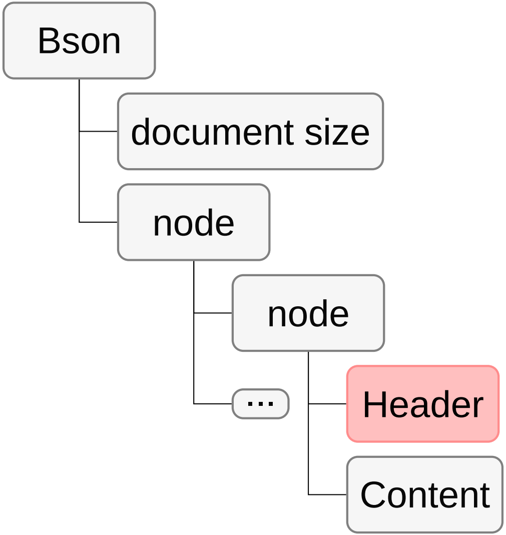
node

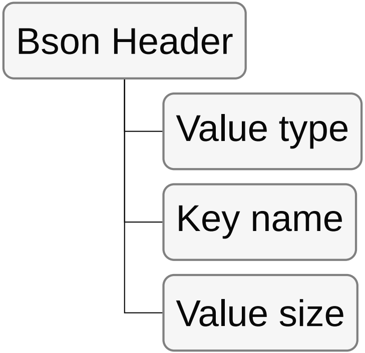
node

...

Header

Content


Bson
document size
node
node
...
Header
Content

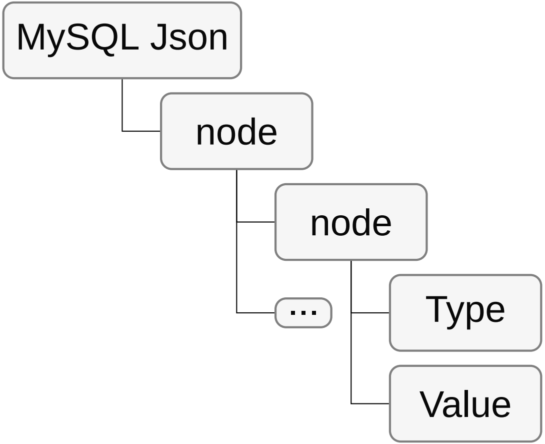


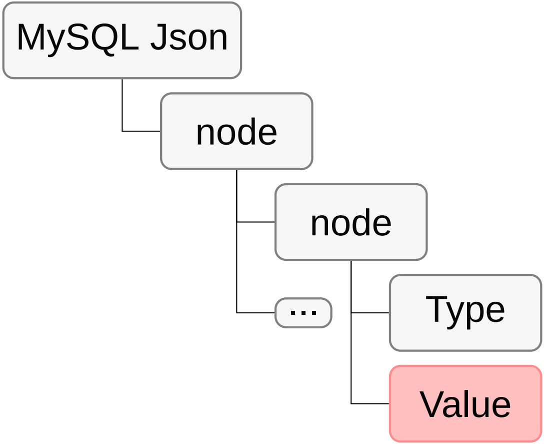
Bson Header

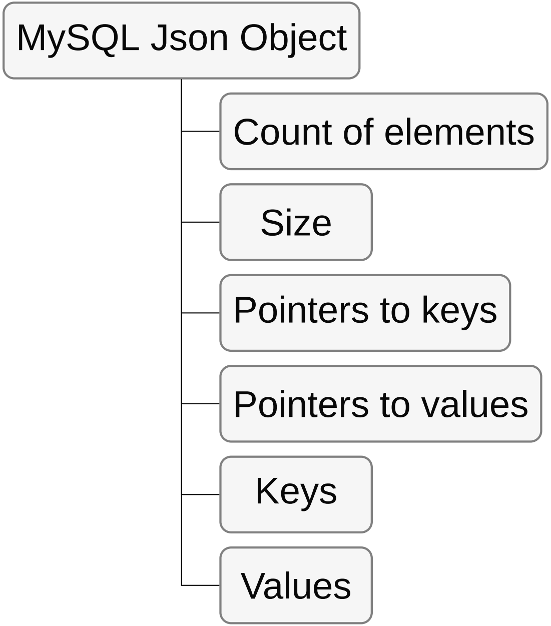
Value type

Key name

Value size

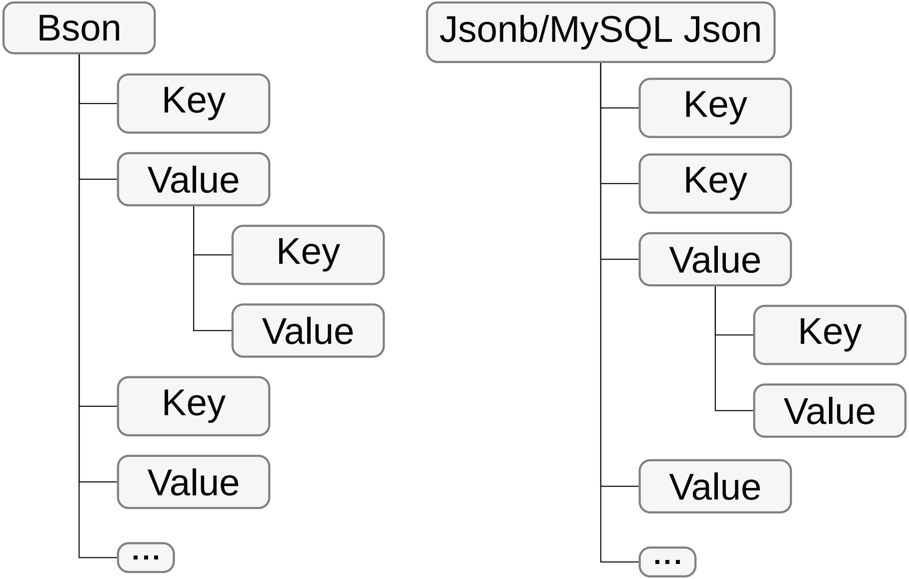

MySQL Json
node
node
...
Type
Value


MySQL Json
node
node
...
Type
Value



MySQL Json Object

- Count of elements
- Size
- Pointers to keys
- Pointers to values
- Keys
- Values



Bson

Key

Value

Key

Value

Key

Value

...

Jsonb/MySQL Json

Key

Key

Value

Key

Value

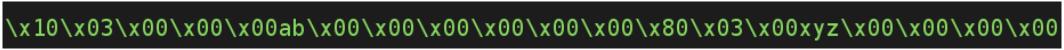
Value

...

```
{”a”: 3, ”b”: ”xyz”}
```

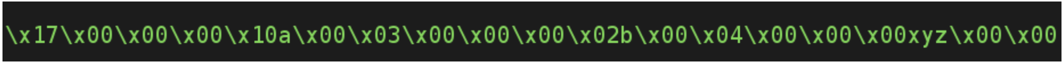
```
select pg_relation_filepath(oid),
relpages from pg_class
where relname = 'table_name';

 pg_relation_filepath | relpages
----------------------+----------
 base/40960/325477    |        0
(1 row)
```



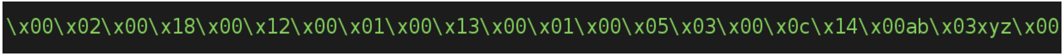
```
\x10\x03\x00\x00\x00ab\x00\x00\x00\x00\x00\x00\x80\x03\x00xyz\x00\x00\x00\x00
```

```
bson.dumps({”a”: 3, ”b”: u”xyz”})
```



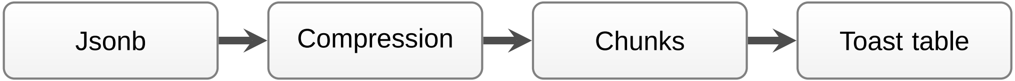
```
\x17\x00\x00\x00\x10a\x00\x03\x00\x00\x00\x02b\x00\x04\x00\x00\x00xyz\x00\x00
```

```
$ hexdump -C database/table.ibd
```



```
\x00\x02\x00\x18\x00\x12\x00\x01\x00\x13\x00\x01\x00\x05\x03\x00\x0c\x14\x00ab\x03xyz\x00
```

TOAST

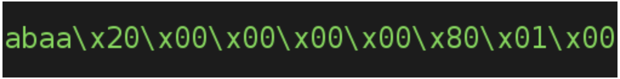


- TOAST_TUPLE_THRESHOLD bytes (normally 2 kB)
- PostgreSQL and MySQL use LZ variation
- MongoDB uses snappy block compression

Alignment

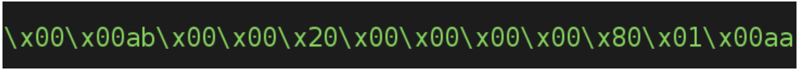
Variable-length portion is aligned to a 4-byte

```
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
```

In-memory representation

- ➔ Tree-like representation (JsonbValue, Document, Json_dom)
- ➔ Little bit more expensive but more convenient to work with
- ➔ Mostly in use to modify data (except MySQL)
- ➔ Most of the read operations use on-disk representation

Indexing support

- ➔ Postgresql – single field, multiple fields, entire document
- ➔ MongoDB – single field, multiple fields
- ➔ MySQL – virtual columns, single field, multiple fields

PG indexing details

- ➔ JGIN_MAXLENGTH
- ➔ jsonb_path
- ➔ jsonb_path_ops

Benchmarks

GREAT PERFORMANCE

AWS EC2

m4.xlarge instance

separate instance (database and generator)

16GB memory, 4 core 2.3GHz

Ubuntu 16.04

Same VPC and placement group

AMI that supports HVM virtualization type

at least 4 rounds of benchmark

PostgreSQL 9.6.3

MySQL 5.7.9

MongoDB 3.4.4

YCSB 0.9

10^6 rows and operations

AWS EC2

Configuration

shared_buffers

effective_cache_size

max_wal_size

innodb_buffer_pool_size

write concern level (journaled or transaction_sync)

Document types

“simple” document

10 key/value pairs (100 characters)

“large” document

100 key/value pairs (200 characters)

“complex” document

100 keys, 3 nesting levels (100 characters)

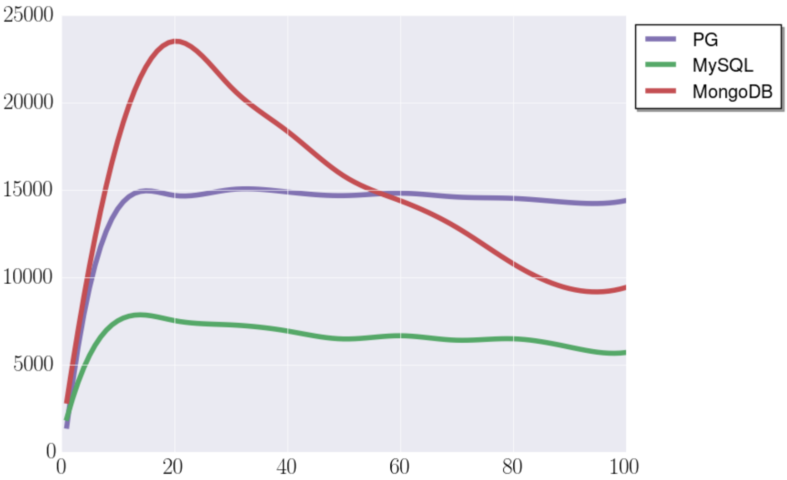
Select, GIN

”simple” document

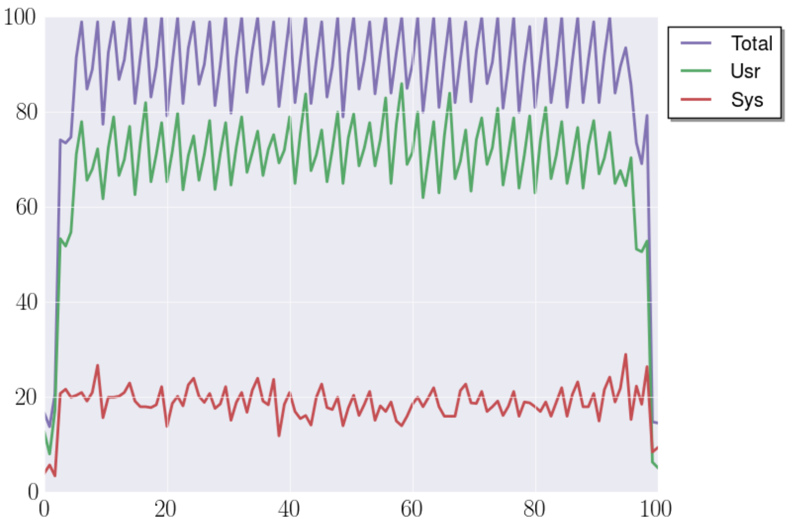
jsonb_path_ops

where data @> '{”key”: ”value”}'::jsonb

Throughput (ops/sec)



CPU%

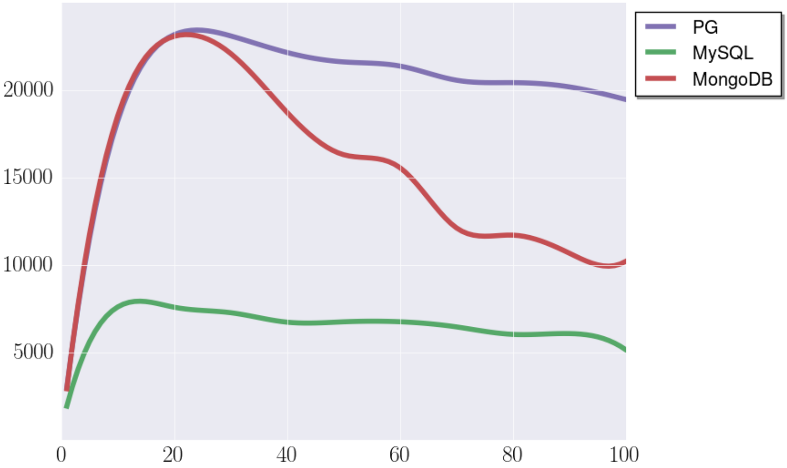


Select, BTree

”simple” document

btree

Throughput (ops/sec)

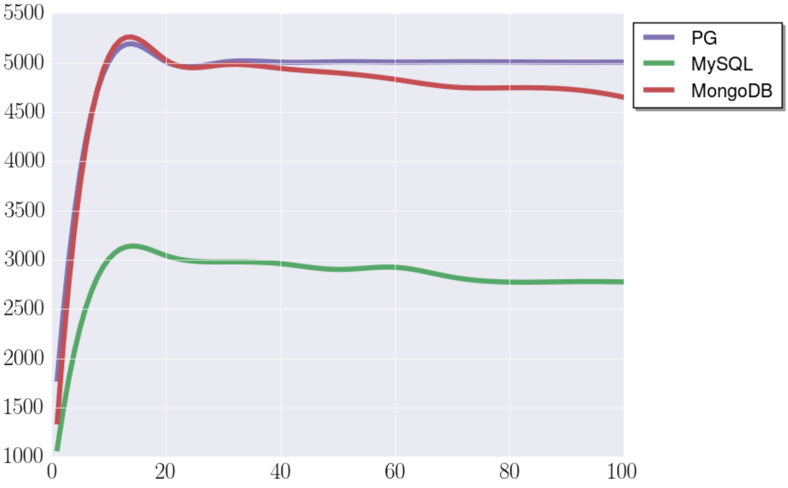


Select, BTree

”complex” document

btree

Throughput (ops/sec)



Scalability

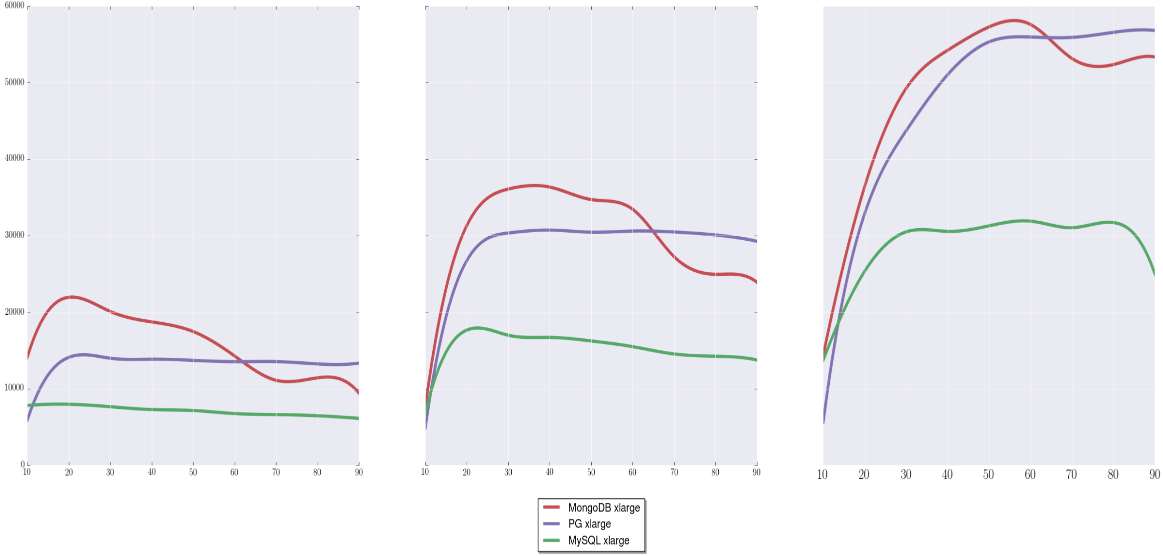
”simple” document

m4.large

m4.xlarge

m4.2xlarge

Throughput (ops/sec)



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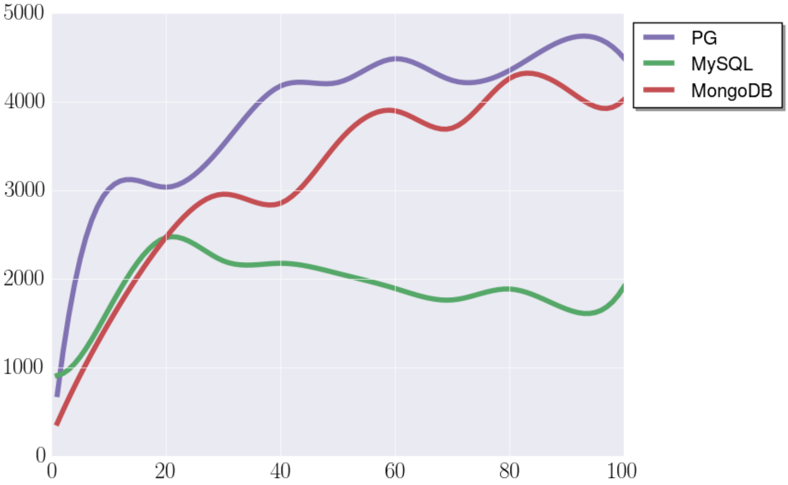
Insert

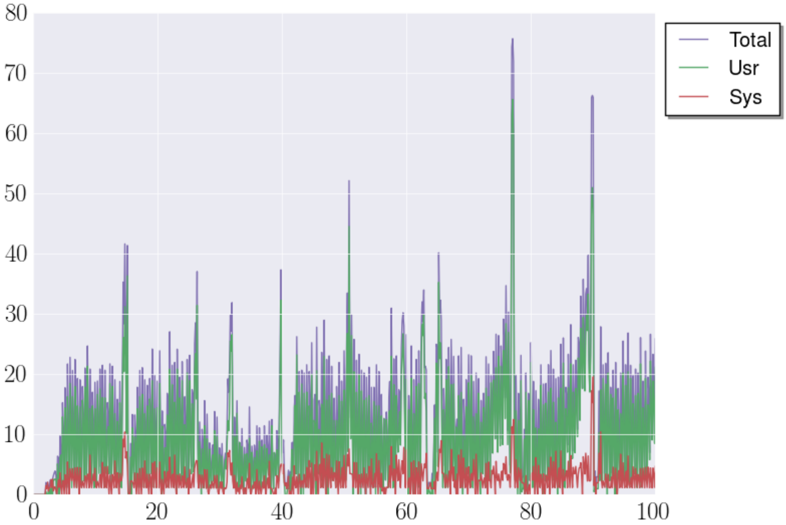
”simple” document

journaled

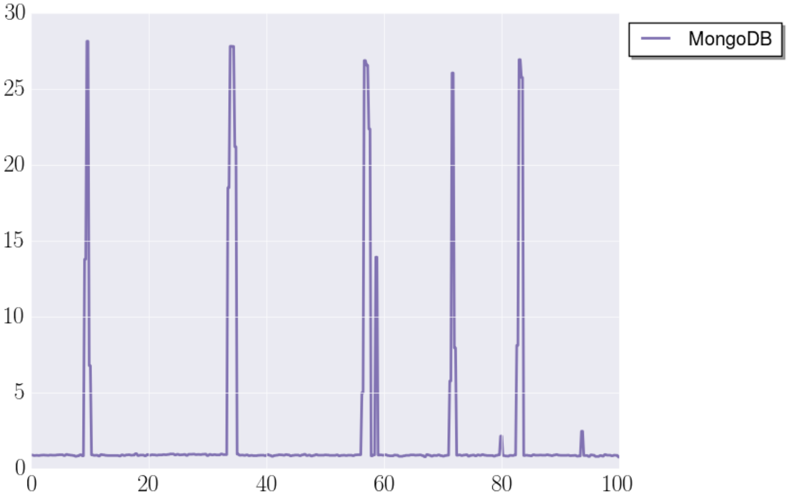
Throughput (ops/sec)



CPU%



IO queue size



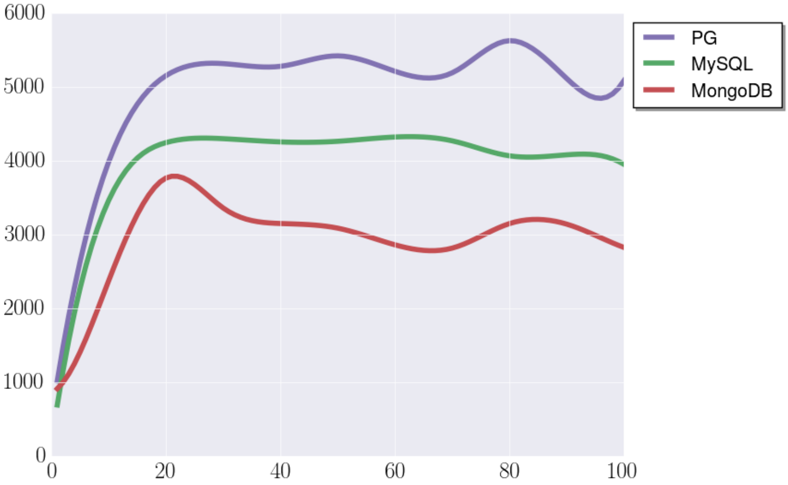
Update 50%, Select 50%

”simple” document

Update one field

transaction_sync

Throughput (ops/sec)

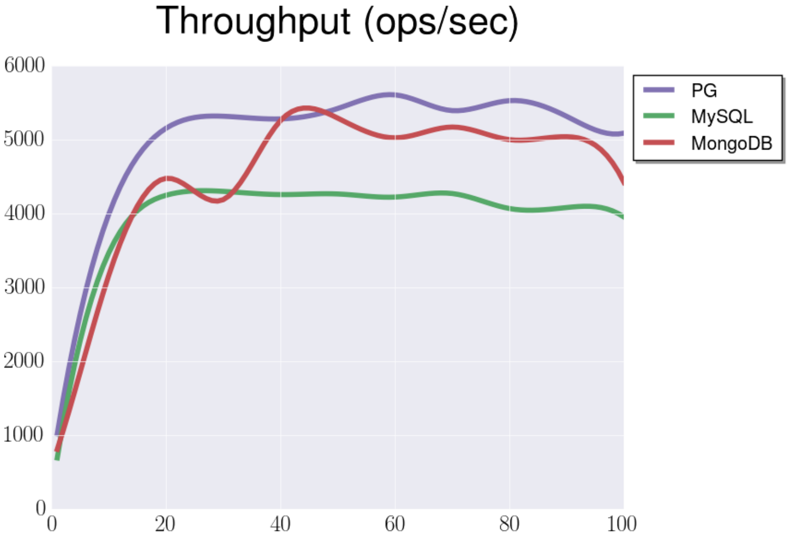


Update 50%, Select 50%

”simple” document

Update one field

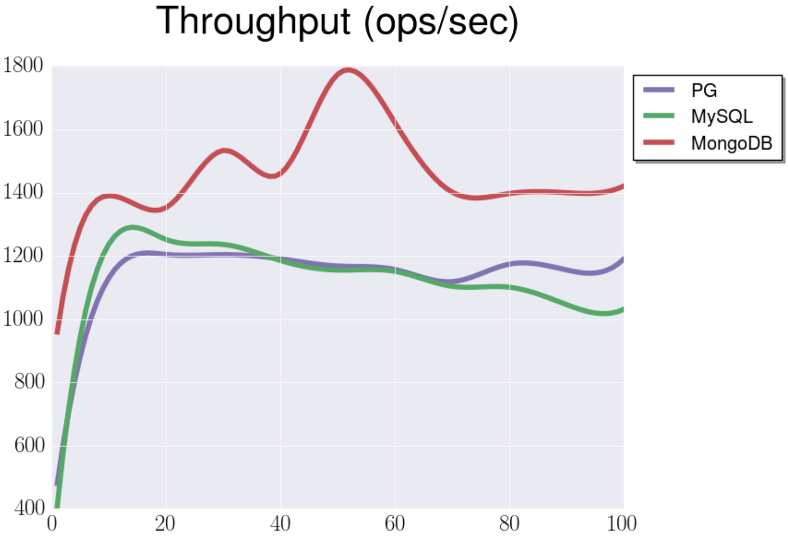
journaled


Throughput (ops/sec)
6000
5000
4000
3000
2000
1000
0
0
20
40
60
80
100
PG
MySQL
MongoDB

Update 50%, Select 50%

”large” document

Update one field


Throughput (ops/sec)
1800
1600
1400
1200
1000
800
600
400
0
20
40
60
80
100
PG
MySQL
MongoDB

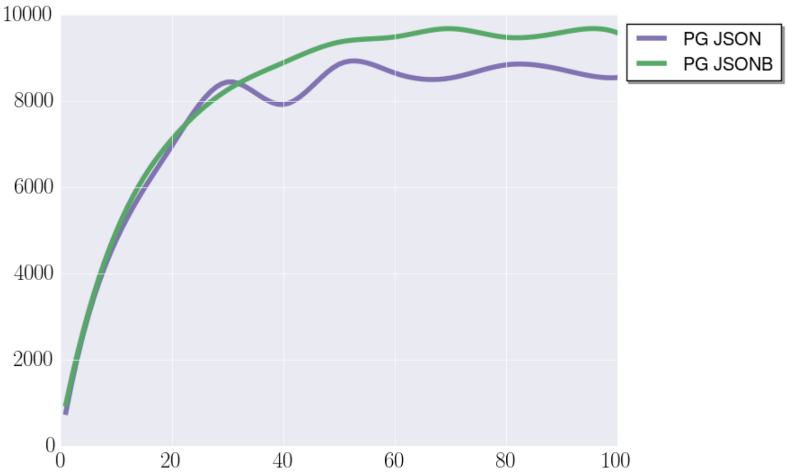
JSON vs JSONB

”simple” document

btree

insert

Throughput (ops/sec)



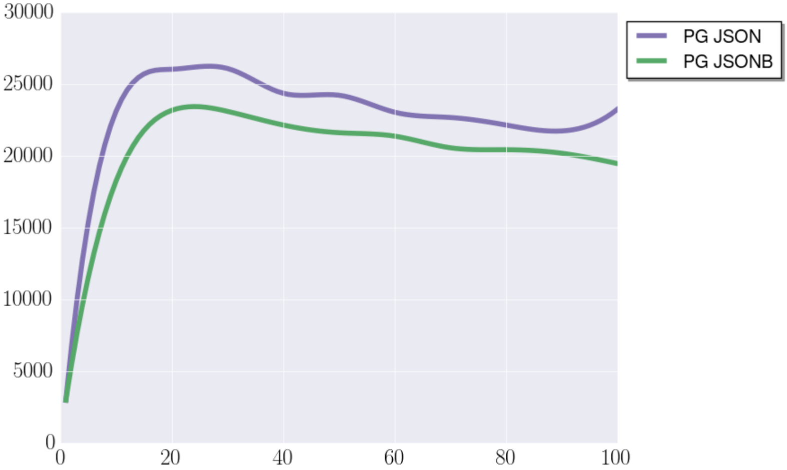
JSON vs JSONB

”simple” document

btree

select

Throughput (ops/sec)



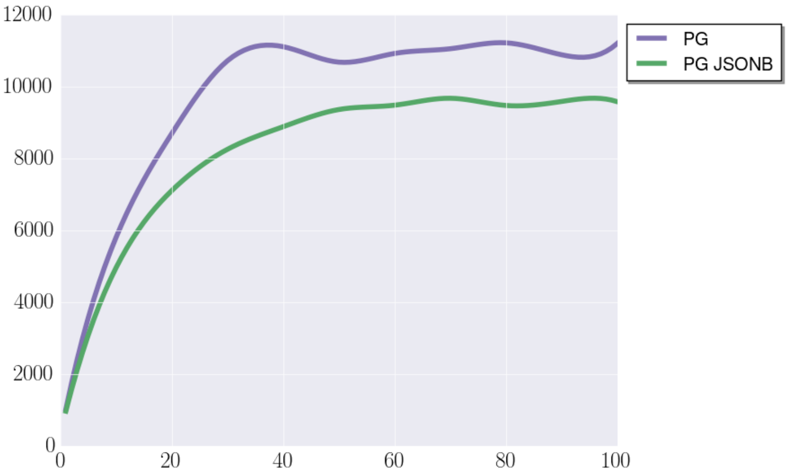
SQL vs JSONB

”simple” document

btree

insert

Throughput (ops/sec)



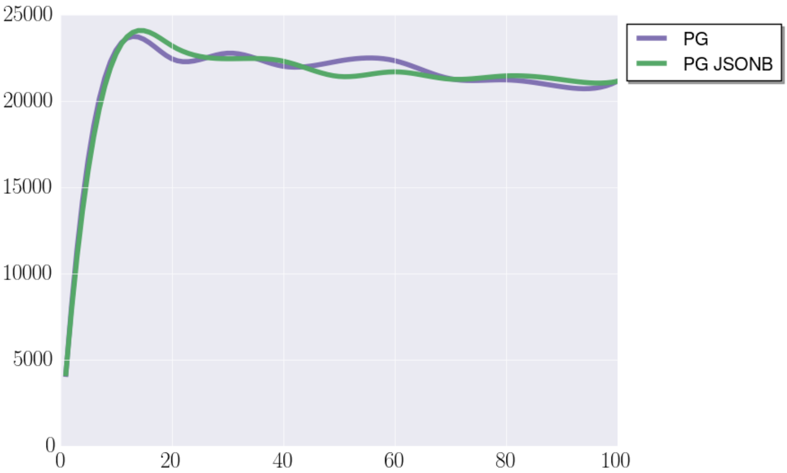
SQL vs JSONB

”simple” document

btree

select

Throughput (ops/sec)



How to bring it down accidentally?

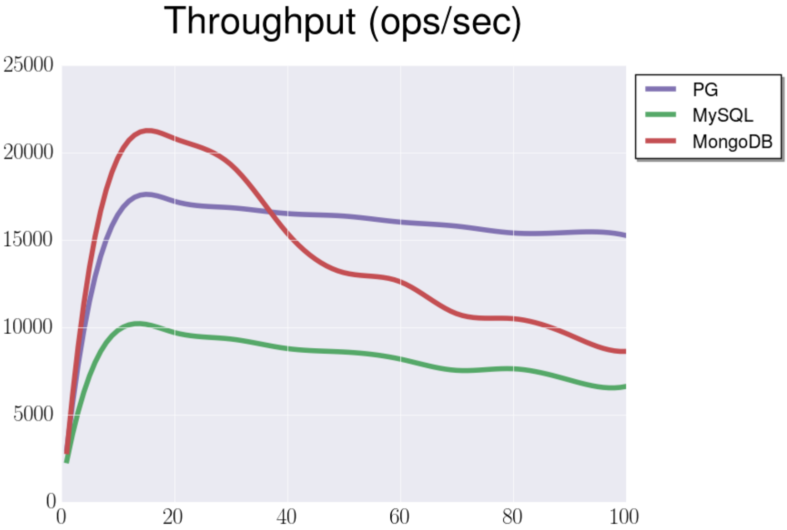
WHAT COULD POSSIBLY GO WRONG?

- ➔ Update one field of a document
- ➔ DETOAST of a document
  (select, constraints, procedures etc.)
- ➔ Reindex of an entire document

Document slice

”large” document

One field from a document

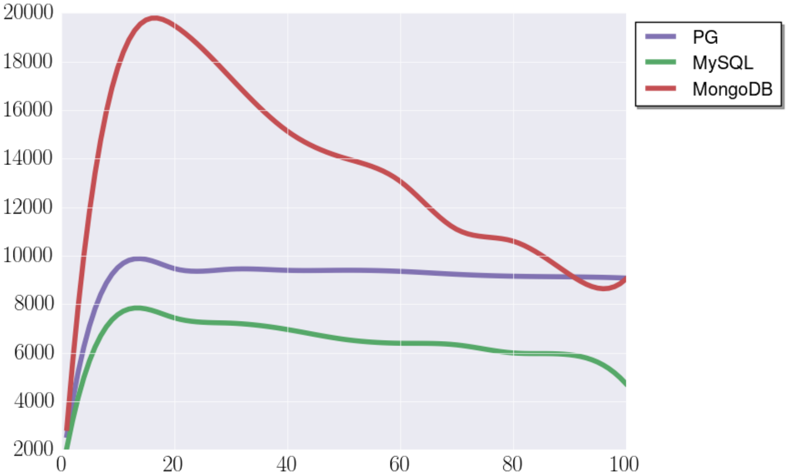

Throughput (ops/sec)
25000
20000
15000
10000
5000
0
0
20
40
60
80
100
PG
MySQL
MongoDB

Document slice

”large” document

10 fields from a document

Throughput (ops/sec)



Document slice

```
create type test as (”a” text, ”b” text);
insert into test_jsonb
values('{”a”: 1, ”b”: 2, ”c”: 3}');
select q.* from test_jsonb,
jsonb_populate_record(NULL::test, data) as q;
 a | b
---+---
 1 | 2
(1 row)
```

SET STORAGE EXTERNAL

TOAST_TUPLE_THRESHOLD

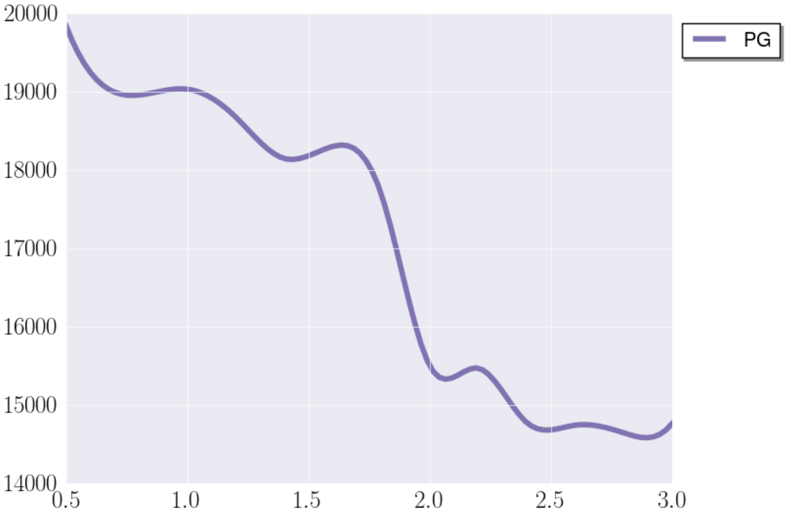
”simple” document

40 threads

different document size

select

Throughput, 40 clients



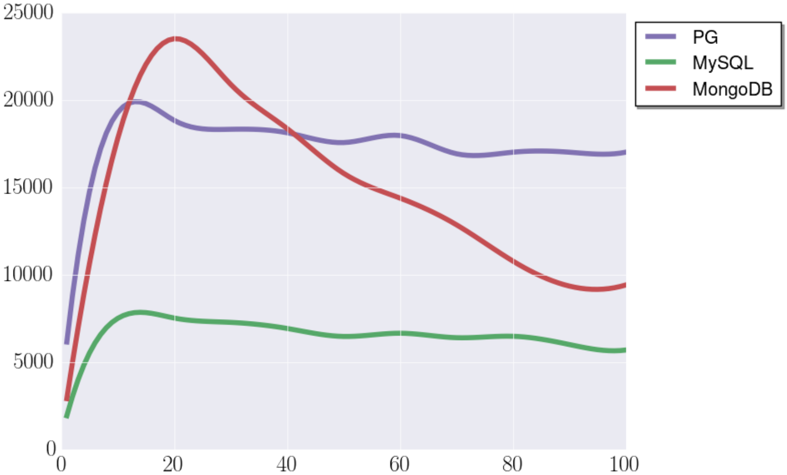
Select, GIN

”simple” document

jsonb_path_ops

where data @> jsonb_build_object(‘key’, ’value’)

Throughput (ops/sec)



➔ Jsonb is more that good for many use cases

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- ➔ Benchmarks above are only ”hints”

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- ➔ Benchmarks above are only ”hints”
- ➔ You need your own tests

Questions?

github.com/erthalion

@erthalion

9erthalion6 at gmail dot com