PoWA 3

June, 28 2016 - 5432... Meet us!

true

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DATE: June, 28 2016 - 5432... Meet us!

Authors

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  - DBA @ Dalibo
  - Open-Source: Multicorn…
  - Some PostgreSQL contributions (IMPORT FOREIGN SCHEMA…)
- Julien Rouhaud
  - DBA @ Dalibo
  - Open-Source: HypoPG, OPM…
  - Some PostgreSQL contributions
- But also…
  - Marc Cousin
  - Thomas Reiss

PoWA ?

What is PoWA

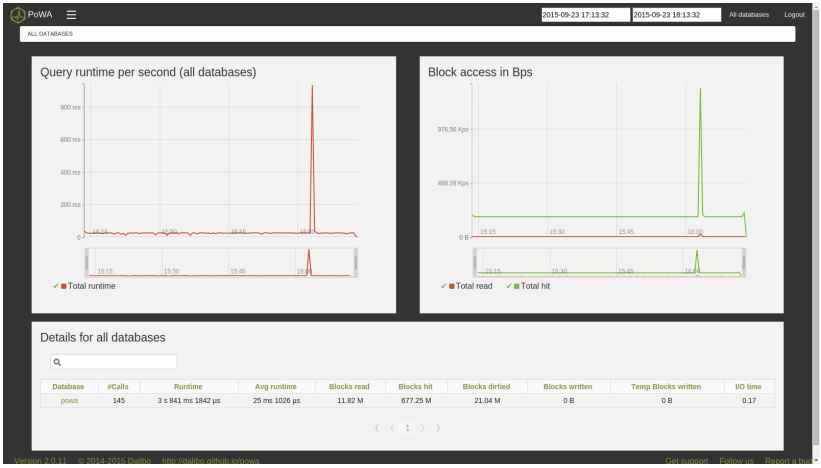
[t]

2cm

true

POWA

5cm



- Workload analysis tool
- Suggests opitmizations

DALIBO

- Live!

Application stack

Presentation

- pg_stat_statements
- github.com/dalibo/pg_stat_kcache
- github.com/dalibo/pg_qualstats
- github.com/dalibo/powa-archivist
- github.com/dalibo/powa-web

pg_stat_statements

Presentation

- Official PostgreSQL contrib
- Normalized queries
- Cumulative counters (buffers, execution time…), by
  - user
  - database
  - query

pg_stat_statements

Useful indicators

- Number of execution per normalized query
- Average execution time
- Temporary file creation
- Blocks access from or outside **PostgreSQL**'s cache

pg_stat_statements

In action 1

pg_stat_statements

true

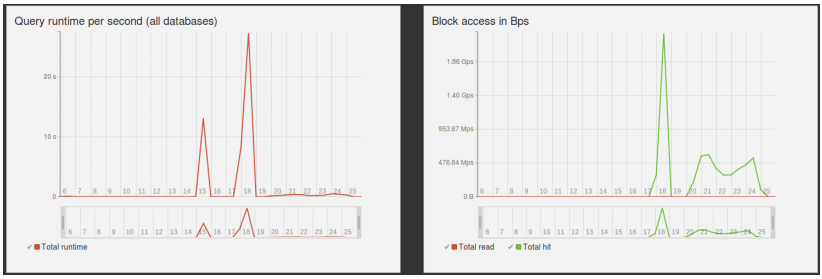
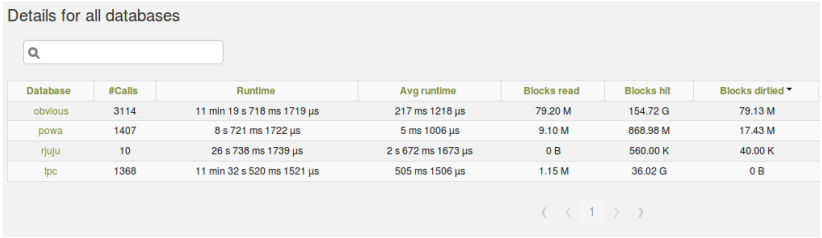


FIGURE 1: IMAGE

In action 2



Database	#Calls	Runtime	Avg runtime	Blocks read	Blocks hit	Blocks dirtied
obvious	3114	11 min 19 s 718 ms 1719 µs	217 ms 1218 µs	79.20 M	154.72 G	79.13 M
powa	1407	8 s 721 ms 1722 µs	5 ms 1006 µs	9.10 M	868.98 M	17.43 M
rjuju	10	26 s 738 ms 1739 µs	2 s 672 ms 1673 µs	0 B	560.00 K	40.00 K
tpc	1368	11 min 32 s 520 ms 1521 µs	505 ms 1506 µs	1.15 M	36.02 G	0 B

FIGURE 2: IMAGE

pg_stat_kcache

Presentation

- Collects system metrics, by normalized queries
  - Physical disk access
  - CPU usage

pg_stat_kcache

Meaning...

- “real” hit-ratio (PostgreSQL cache Vs system cache)
- Identify CPU bound queries

pg_stat_kcache

In action 1

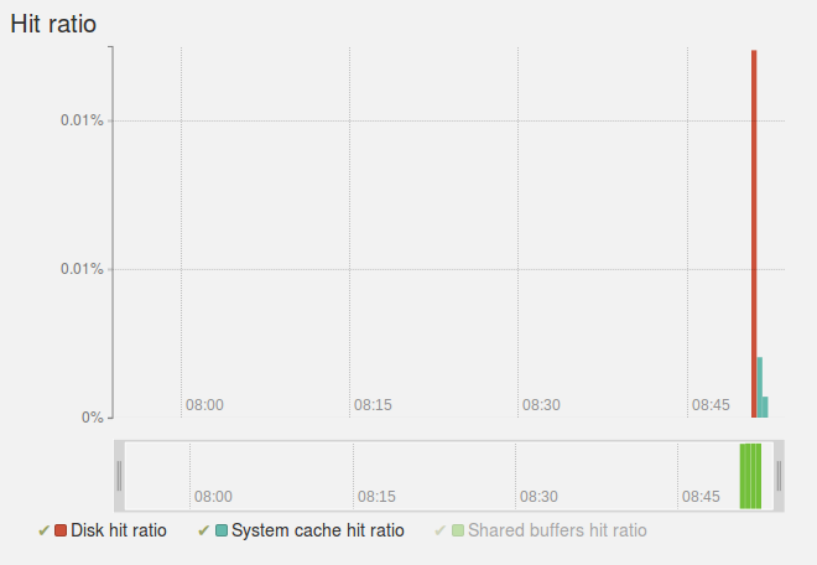


FIGURE 3: IMAGE

pg_stat_kcache

In action 2

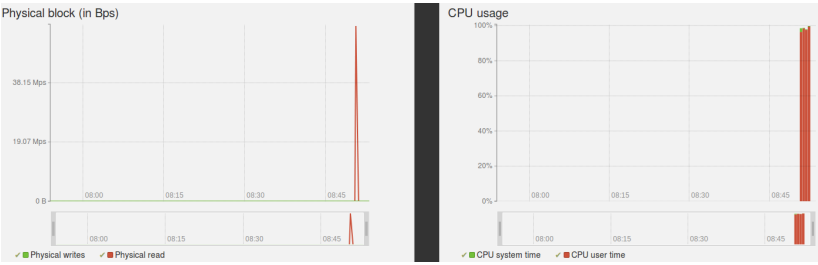


FIGURE 4: IMAGE

pg_qualstats

Presentation

true

- Predicate analysis
  - WHERE clauses
  - JOIN clauses
- Collects various metrics
  - Selectivity
  - Constants sampling (most executed, most filtering...)
  - Execution count
  - Evalutation type (Index clause or post-scan filtering)

pg_qualstats

In action 1

```
SELECT
    com.id,
    sum (
        c_l.price ) AS total_price
FROM
    command com
    JOIN command_line c_l ON com.id = c_l.id_command
    JOIN client cli ON cli.id = com.id_client
WHERE
    cli.id = ?
GROUP BY
    com.id;
```

FIGURE 5: IMAGE

pg_qualstats

In action 2

pg_qualstats

In action 3

pg_qualstats

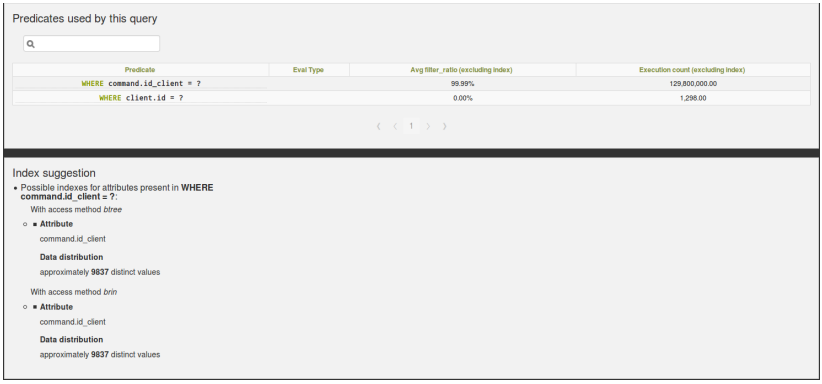


FIGURE 6: IMAGE

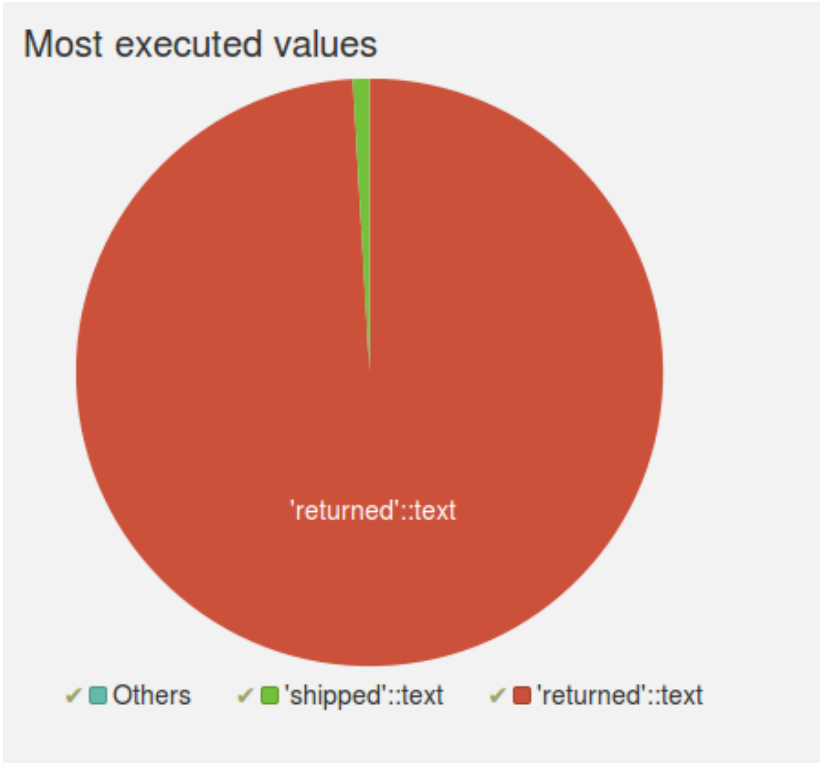


FIGURE 7: IMAGE

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In action 4

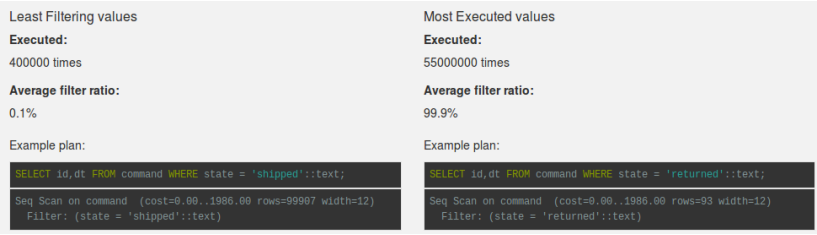

FIGURE 8: IMAGE

powa-archivist

Presentation

- Archive those data sources
- Configurable (retention, frequency...)
- Extensible to other datasources

powa-archivist

What to get

- Where / when are the bottlenecks
- For what reason
- How to fix
- Live!

Compatibility

- PostgreSQL **9.4** et later
- PoWA 1 compatible with 9.3, but much more limited

powa-web

Presentation

- Web interface for PoWA
- Manage one or more PoWA instance
- Drill-down analysis

powa-web

Usage example

- problem: bad performance on parts of an application
- Select an analysis period
- Identify the database

powa-web

cluster view - 1

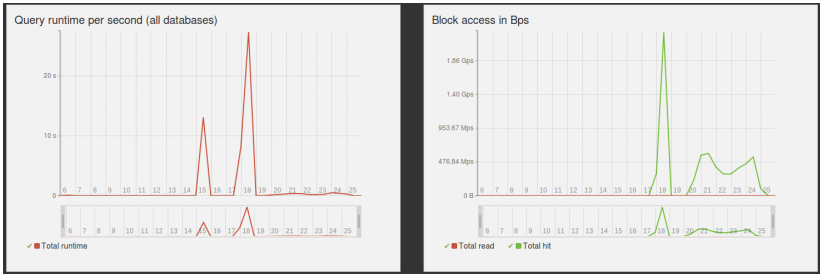

FIGURE 9: IMAGE

powa-web

cluster view - 2

powa-web

Database view

- Problematic database has been identified...
- let's drill down to the query level!

powa-web

true

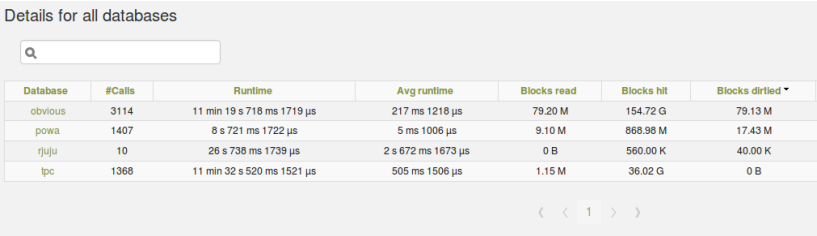

FIGURE 10: IMAGE

Database view - 1

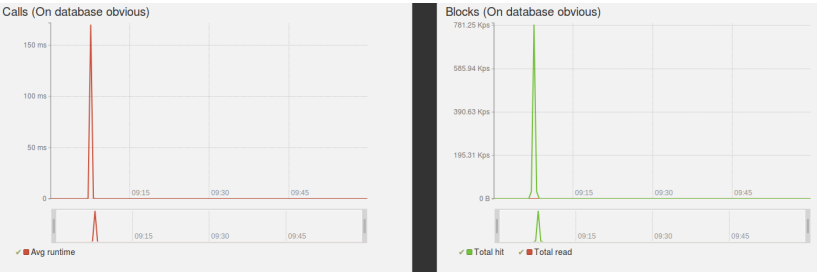

FIGURE 11: IMAGE

powa-web

Database view - 2

powa-web

Database view - 3

powa-web

Query view

- 2 problematic queries
- Drill down on each of them

[fragile]

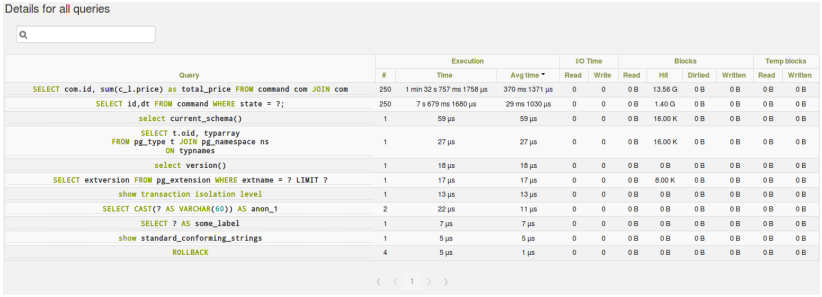

FIGURE 12: IMAGE

Query	Execution		
	#	Time	Avg time
SELECT com.id, sum(c_l.price) as total_price FROM command com JOIN com	250	1 min 32 s 757 ms 1758 µs	370 ms 1371 µs
SELECT id,dt FROM command WHERE state = ?;	250	7 s 679 ms 1680 µs	29 ms 1030 µs
select current_schema()	1	59 µs	59 µs
SELECT t.oid, typarray FROM pg_type t JOIN pg_namespace ns ON typnames	1	27 µs	27 µs
select version()	1	18 µs	18 µs

FIGURE 13: IMAGE

POWA-WEB

First query - SQL

[mathescape, numbersep=5pt, gobble=2, frame=lines, framesep=2mm]sql SELECT com.id, sum(c_l.pric) AS total$_p$rice FROM command com JOIN command$_l$ine c_l ON com.id = c_l.id$_c$ommand JOIN client cli ON cli.id = com.id$_c$lient WHERE cli.id = ? GROUP BY com.id

powa-web

First query - cache

powa-web

First query - CPU

powa-web

First query - predicates

powa-web

true

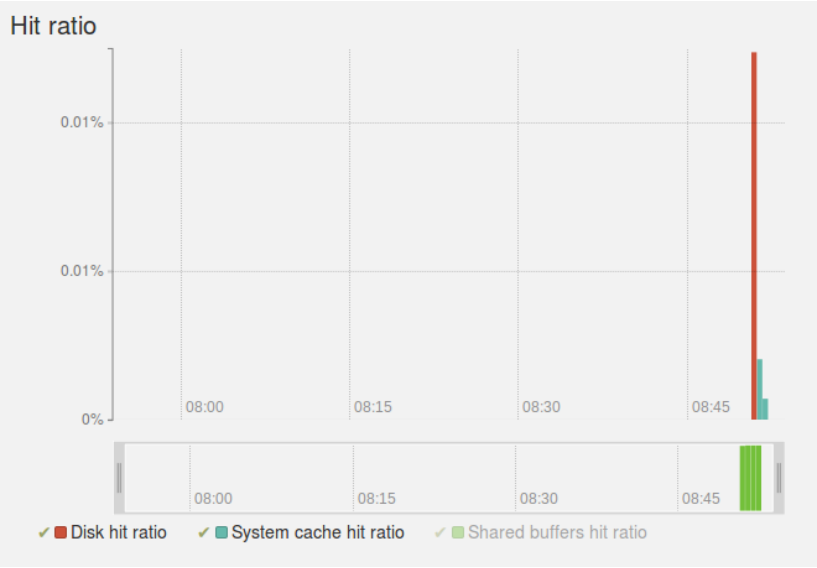

FIGURE 14: IMAGE

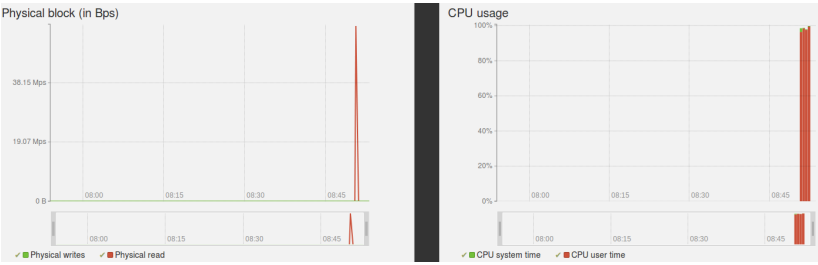

FIGURE 15: IMAGE

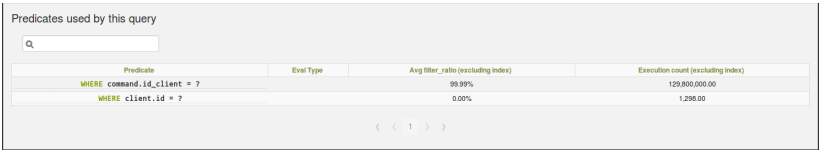

FIGURE 16: IMAGE

First query - index

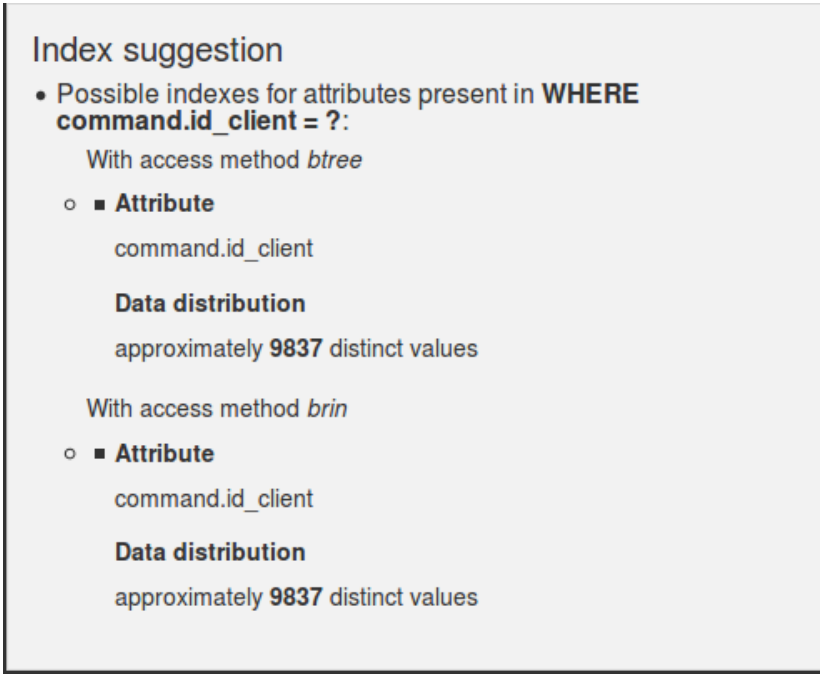

FIGURE 17: IMAGE

[fragile]powa-web

Second query - SQL

[mathescape, numbersep=5pt, gobble=2, frame=lines, framesep=2mm]sql SELECT id, dt FROM command WHERE state = ?

powa-web

Second query - EXPLAIN

powa-web

Second query - distribution

powa-web

true

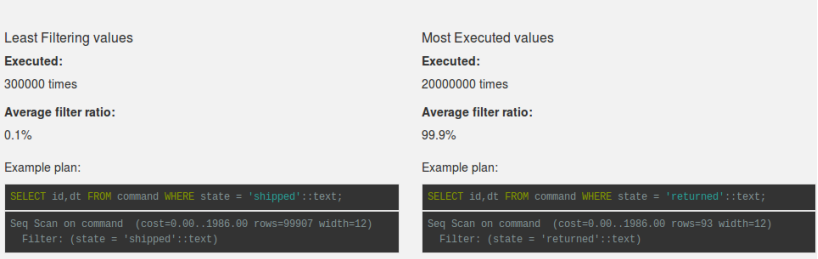

FIGURE 18: IMAGE

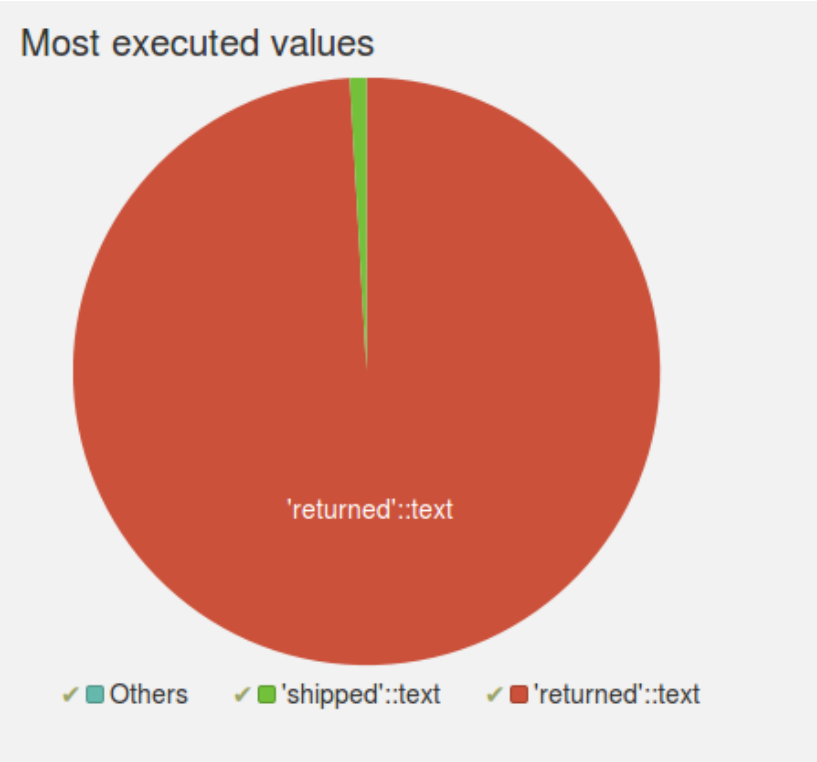

FIGURE 19: IMAGE

Video

-

powa-web

What's new in version 3

- github.com/dalibo/HypoPG extension support
- Global index suggestion

HypoPG

Presentation

- Allow for hypothetical indexes creation
- Instant creation, no impact on resources and no lock
- Only used in EXPLAIN statements

[fragile]HypoPG

Example

[mathescape, numbersep=5pt, gobble=2, frame=lines, framesep=2mm]sql rjuju=# EXPLAIN SELECT * FROM t1 WHERE id = 3 ; QUERY PLAN ———————————————— Seq Scan on t1 (cost=0.00..1693.00 rows=1 width=4) Filter: (id = 3) (2 rows)

[fragile]HypoPG

Example

[mathescape, numbersep=5pt, gobble=2, frame=lines, framesep=2mm]sql # SELECT hypopg$_c$reate$_i$ndex('CREATE INDEX ON t1(id)') ; hypopg$_c$reate$_i$ndex ————————– (77523,<77523>btree$_t$1$_i$d) (1 row)

rjuju=# EXPLAIN SELECT * FROM t1 WHERE id = 3 ; QUERY PLAN ———————————————————————————— Index Only Scan using <77523>btree$_t$1$_i$d on t1 (0.04..8.06 rows=1 width=4) Index Cond: (id = 3) (2 rows)

HypoPG

true

What is it useful for

- Will PostgreSQL use such an index
- What size can I expect it to be
- How useful can it be

HypoPG

In action

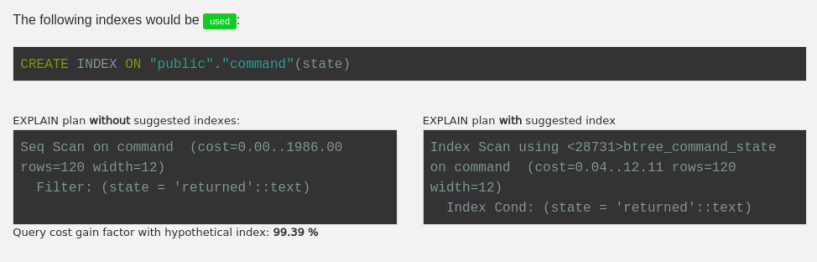

FIGURE 20: IMAGE

Global optimization

Presentation

- Find the optimal set of index to add
  - Helping every queries
  - Minimum set of indexes
  - Privileging multi-column indexes

Global optimization

Algorithm - 1

- Fetch the predicates that need optimization (pg_qualstats)
  - Predicates filtering more than X lines out
  - Predicates filtering more than X% of lines out
  - Predicates used as part of a Seq Scan

Global optimization

Algorithm - 2

- Group predicates by supported access methods
  - ***Hint:*** *Think about btree_gist and btree_gin*
- Build a list of predicates "contained" by each predicates
  - WHERE id = ? AND label = ?
  - WHERE id = ?
  - WHERE label = ?
- For each node, attribute a "score" to it (currently, number of columns)

Global optimization

Algorithm - 3

- For each node, compute a path containing all included node
- Score it (sum of individual nodes scores)
- Starting with the highest scoring path, generate the index definition for it
- Delete any other path made obsolete by this one
- Loop until no path is left unoptimized

Global optimization

Validation

- Goal: estimate if the indexes will be used, and how much improvement they bring
- If HypoPG is available on the target database:
  - Create hypothetical index for each suggestion
  - EXPLAIN every query with and without the hypothetical indexes
  - Based on the difference cost, estimate the gain
  - If HypoPG is available on the target database:
    - By query
    - Globally
  - Estimate the size of the indexes

Global optimization

true

In action

Query	#
SELECT pg_sleep(?);	59
SELECT * FROM contacts;	10
SELECT numero_commande, etat_commande FROM commandes WHERE client_id =	10
SELECT * FROM clients cl JOIN contacts co ON co.contact_id = cl.contac	10
SELECT COUNT(*) FROM commandes WHERE date_commande BETWEEN (? || ?)::d	10
SELECT count(*) FROM commandes cmd JOIN lignes_commandes lc ON lc.nume	10
SELECT COUNT(*) FROM pays p JOIN contacts con ON con.code_pays = p.cod	10
SELECT numero_commande, etat_commande FROM commandes WHERE client_id =	10
SELECT count(*) FROM commandes cmd JOIN lignes_commandes lc ON lc.nume	10
SELECT co.nom FROM clients cl JOIN contacts co ON co.contact_id = cl.c	10
SELECT con.nom || ? || code_pays || ? FROM clients cli JOIN contacts c	10
SELECT COUNT(*) FROM pays p JOIN contacts con ON con.code_pays = p.cod	10
SELECT region_id FROM regions WHERE nom_region = ?;	10
SELECT COUNT(*) FROM pieces_fournisseurs WHERE cout_piece >= ?	10
SELECT COUNT(*) FROM commandes WHERE date_commande BETWEEN (? || ?)::d	10
SELECT numero_commande, etat_commande FROM commandes WHERE client_id =	10
SELECT nom FROM contacts c JOIN pays p ON p.code_pays = c.code_pays WH	10
SELECT COUNT(*) FROM commandes WHERE client_id = ? AND priorite_comman	10
SELECT numero_commande, etat_commande FROM commandes WHERE client_id =	10
SELECT COUNT(*) FROM pieces_fournisseurs WHERE quantite_disponible < ?	10

FIGURE 21: IMAGE

Global optimization

In action

Global optimization

In action

Global optimization

In action

Global optimization

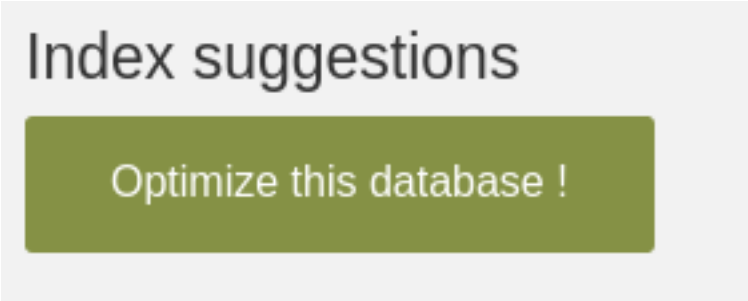

FIGURE 22: IMAGE

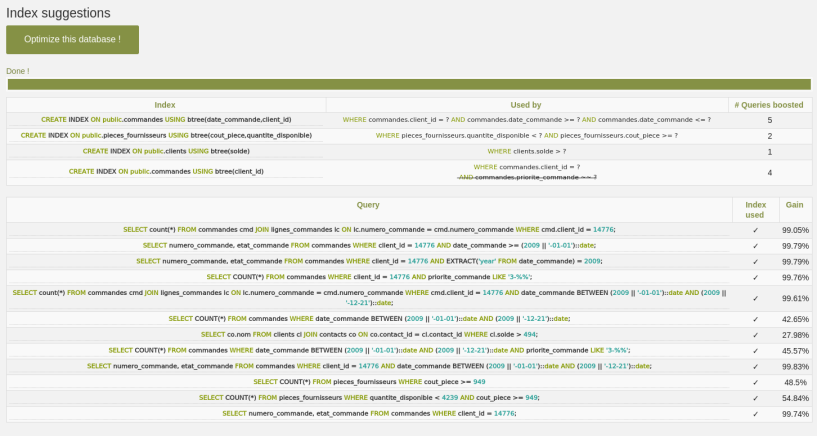

FIGURE 23: IMAGE

Index	Used by	# Queries boosted
`CREATE INDEX ON public.pieces_fournisseurs USING btree(cout_piece,quantite_disponible)`	`WHERE pieces_fournisseurs.quantite_disponible < ? AND pieces_fournisseurs.cout_piece >= ?` `WHERE pieces_fournisseurs.cout_piece >= ?`	2

`CREATE INDEX ON public.commandes USING btree(date_commande,client_id)`	`WHERE commandes.client_id = ? AND commandes.date_commande >= ? AND commandes.date_commande <= ?`
	`WHERE commandes.date_commande <= ? AND commandes.date_commande >= ?`
	`WHERE commandes.client_id = ?`
		5

`CREATE INDEX ON public.clients USING btree(solde)`	`WHERE clients.solde > ?`	2
`CREATE INDEX ON public.commandes USING btree(client_id)`	`WHERE commandes.client_id = ?`	4

FIGURE 24: IMAGE

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Query	Index used	Gain
`SELECT co.nom FROM clients cl JOIN contacts co ON co.contact_id = cl.contact_id WHERE cl.solde > 444;`	✓	15.19%
`SELECT COUNT(*) FROM commandes WHERE date_commande BETWEEN (2011 || '-01-01')::date AND (2011 || '-12-21')::date;`	✓	84.14%
`SELECT numero_commande, etat_commande FROM commandes WHERE client_id = 14608 AND EXTRACT('year' FROM date_commande) = 2011;`	✓	99.83%
`SELECT COUNT(*) FROM pieces_fournisseurs WHERE quantite_disponible < 7126 AND cout_piece >= 956;`	✓	93.98%
`SELECT COUNT(*) FROM commandes WHERE date_commande BETWEEN (2011 || '-01-01')::date AND (2011 || '-12-21')::date AND priorite_commande LIKE '3-%%';`	✓	45.69%
`SELECT con.nom || ' (' || code_pays || ' )' FROM clients cli JOIN contacts con ON con.contact_id = cli.contact_id WHERE solde > 444;`	✓	14.54%
`SELECT numero_commande, etat_commande FROM commandes WHERE client_id = 14608 AND date_commande >= (2011 || '-01-01')::date;`	✓	99.83%
`SELECT numero_commande, etat_commande FROM commandes WHERE client_id = 14608 AND date_commande BETWEEN (2011 || '-01-01')::date AND (2011 || '-12-21')::date;`	✓	99.86%
`SELECT count(*) FROM commandes cmd JOIN lignes_commandes lc ON lc.numero_commande = cmd.numero_commande WHERE cmd.client_id = 14608 AND date_commande BETWEEN (2011 || '-01-01')::date AND (2011 || '-12-21')::date;`	✓	27.09%
`SELECT count(*) FROM commandes cmd JOIN lignes_commandes lc ON lc.numero_commande = cmd.numero_commande WHERE cmd.client_id = 14608;`	✓	17.35%
`SELECT numero_commande, etat_commande FROM commandes WHERE client_id = 14608;`	✓	99.78%
`SELECT COUNT(*) FROM pieces_fournisseurs WHERE cout_piece >= 956`	✓	93.25%
`SELECT COUNT(*) FROM commandes WHERE client_id = 14608 AND priorite_commande LIKE '3-%%';`	✓	99.8%

FIGURE 25: IMAGE

In action

Global optimization

In action

- vidéo

What's next

Future enhancements

- Find correlations, and suggest them once correlated statistics are available
  - WHERE cityname = ? AND zipcode = ? (10 rows avg)
  - WHERE cityname = ? (10 rows avg)
  - WHERE zipcode = ? (10 rows avg)
  - It means that cityname and zipcode are probably correlated
- Collect statistics on table to take DML workload into account
- Suggest partial indexes based on most-often used values

Useful links

- powa-archivist
  - dalibo.github.io/powa (website)
  - github.com/dalibo/powa-archivist (repository)
- powa-web
  - github.com/dalibo/powa-web (repository)
  - demo-powa.dalibo.com (demo)
- pg_qualstats
  - github.com/dalibo/pg_qualstats (repository)
  - article on rdunklau.github.io
- pg_stat_kcache
  - github.com/dalibo/pg_stat_kcache (repository)
  - article on rjuju.github.io
- HypoPG
  - dalibo.github.io/hypopg (website)
  - github.com/dalibo/hypopg (repository)
  - article on rjuju.github.io

Questions ?

- contact@dalibo.com
- powa@dalibo.com
- powa.readthedocs.org

true