
Intro to PostgreSQL:
What To Know When You're Called In To Help
SQL Saturday Pittsburgh
2024
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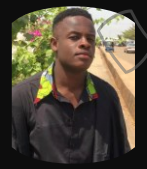



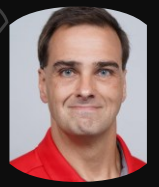

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Simple Talk

A technical journal and community hub

- ✓ Blogs, videos, events, and more
- ✓ Contributions by experts
- ✓ Unbiased, multi-database content

Join the community at Simple-Talk.com

github.com/ryanbooz/presentations

My Journey

Work






Hobby



1999 **2004** **2018** **2020** **2022**

-T2371

Agenda

01 Back to the future

02 Feature Comparison

03 Terminology

04 Architecture

05 Getting Connected

06 Configuration Highlights

07 Create/Backup/Restore

08 SQL Differences

09 Query Tuning

10 Community & Help

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01/10

Back to the future with PostgreSQL

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Post-gres-QL

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Post-gres

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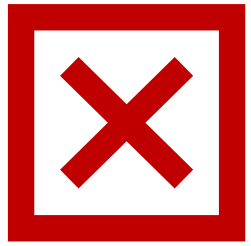

Post-gre

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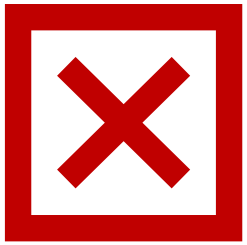

Post-gre-SQL

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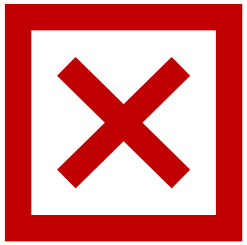

Post-gres-SQL

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Follow
It's really PostgreSQL
@postgre_s
postgresql.org
Joined August 2018
1 Following
86 Followers
Followed by Pavlo Golub, Jessica Sharp, and 7 others you follow

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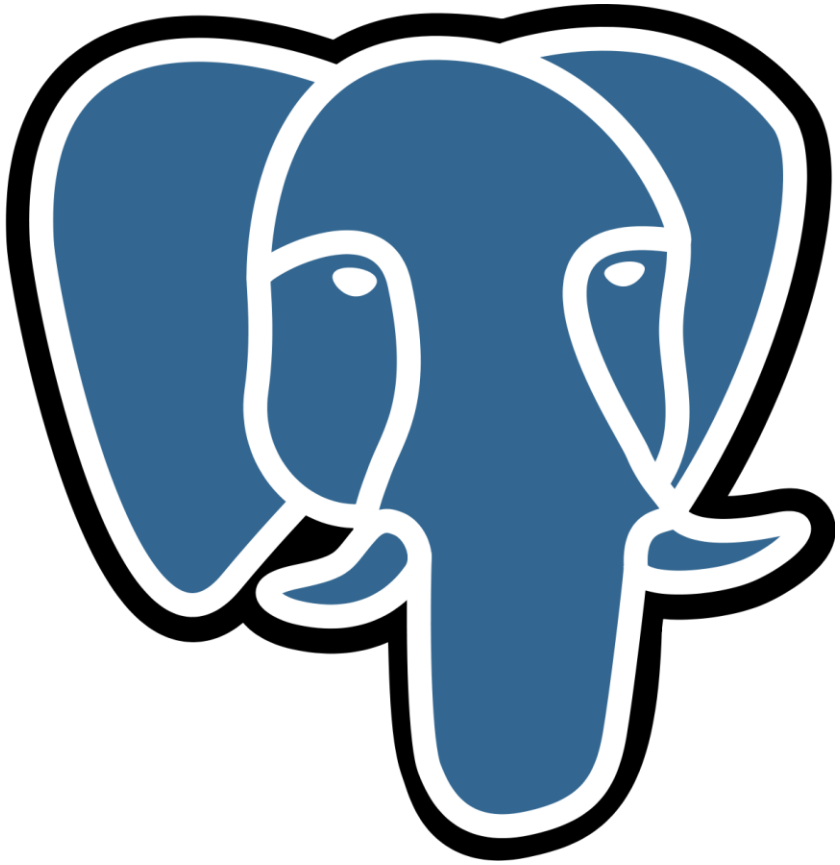

Slonik

(Slony)

1970s

INGRES

1980s

POSTGRES

1995

Postgres95

1996

1. Name changed to PostgreSQL
2. PostgreSQL Global Development Group
3. PostgreSQL 6.0 released in January 1997

PostgreSQL

- No tiers with a ***very*** permissive license

```
PostgreSQL Database Management System
(formerly known as Postgres, then as Postgres95)

Portions Copyright (c) 1996-2011, PostgreSQL Global Development Group

Portions Copyright (c) 1994, The Regents of the University of California

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Core Team and Contributors

- Set release dates
- Confidential project matters
- Act as spokespeople for the
- Arbitrate community decisions

- Code contributions
- Patch reviewers
- Mailing list moderators
- Active community members

- Core team
- Major contributors

https://www.postgresql.org/community/contributors/

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COMMITFEST

Five each year

Dictates what patches are included in a release

Mailing-list and volunteer led

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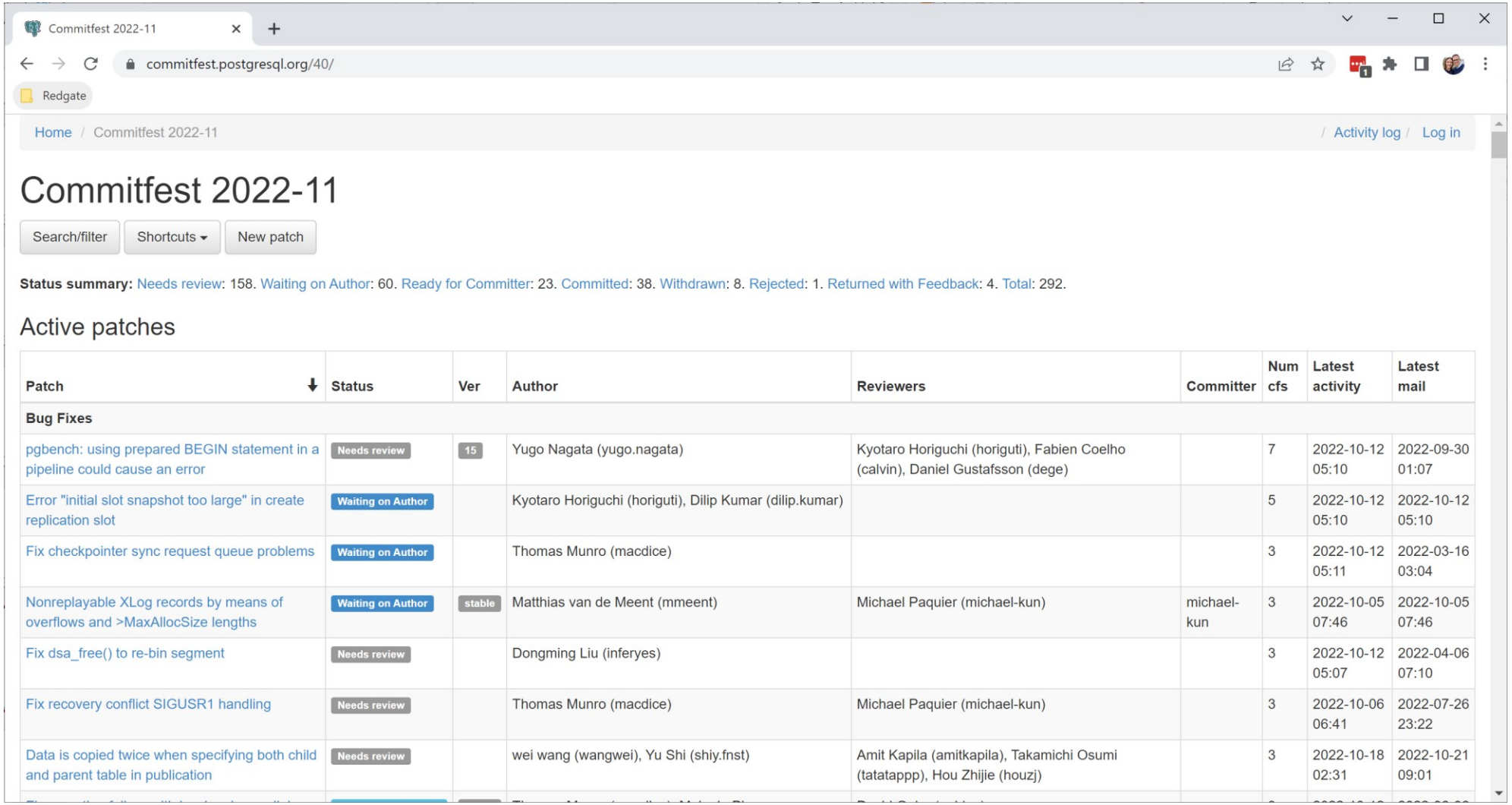

https://commitfest.postgresql.org/

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PostgreSQL Variants

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PostgreSQL Feature Comparison

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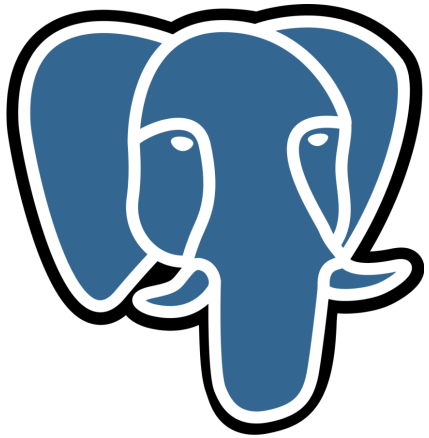
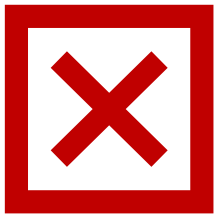
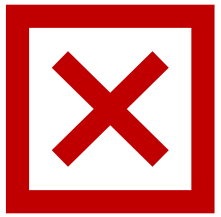
Customizable with Extensions







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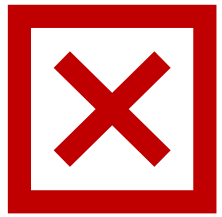
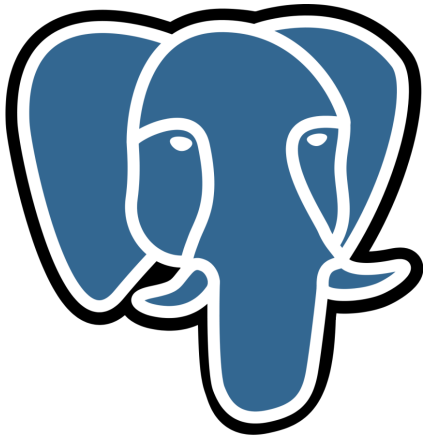
Native JSON/JSONB Datatype





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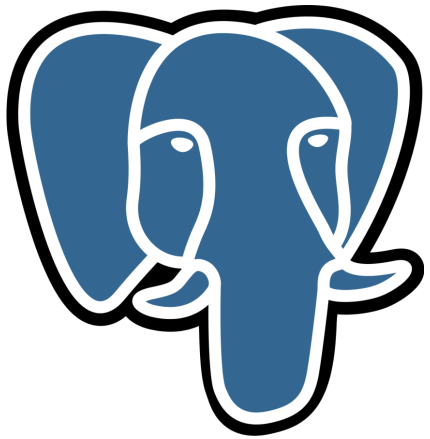
Multiple Index Types

2

2



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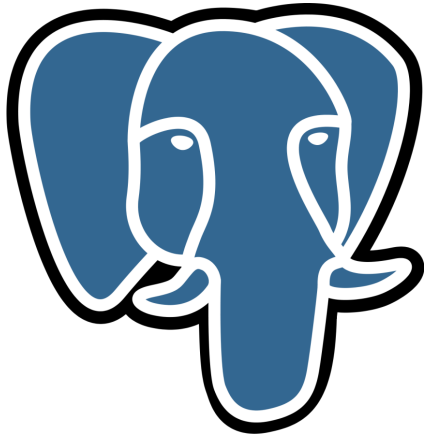
Native Partitioning



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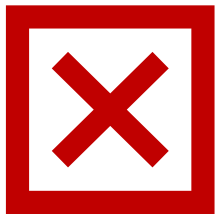
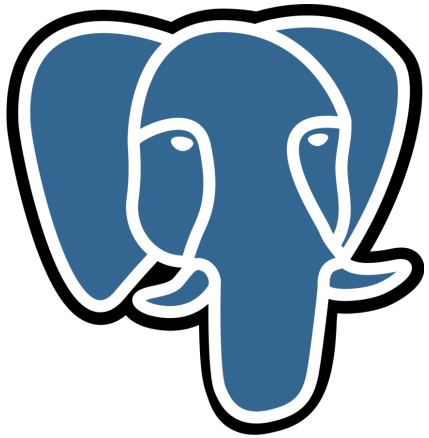
Function/Procedure Multi-language Support





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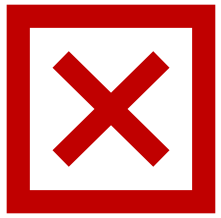
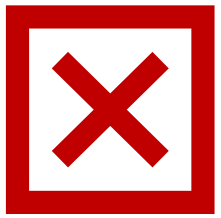
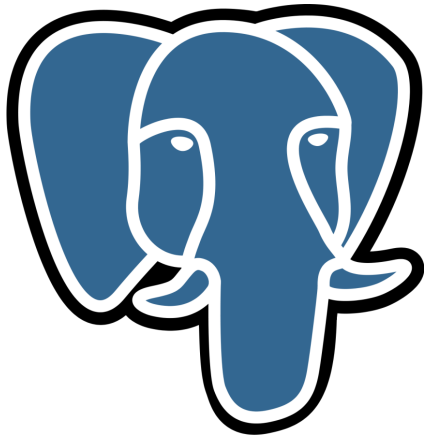
Transactional DDL







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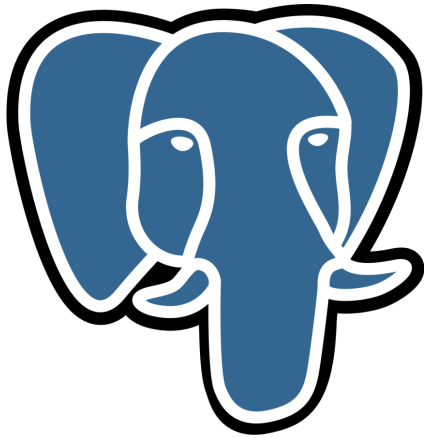
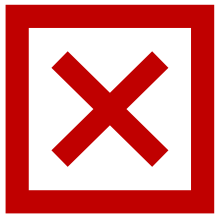
Query Hints





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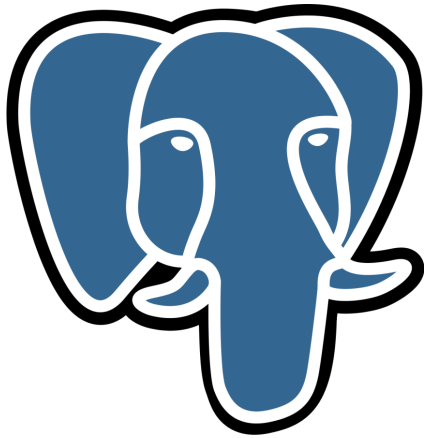
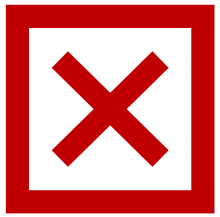
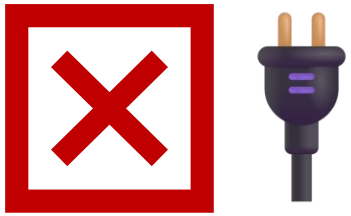
Visual Query Plan Explorer







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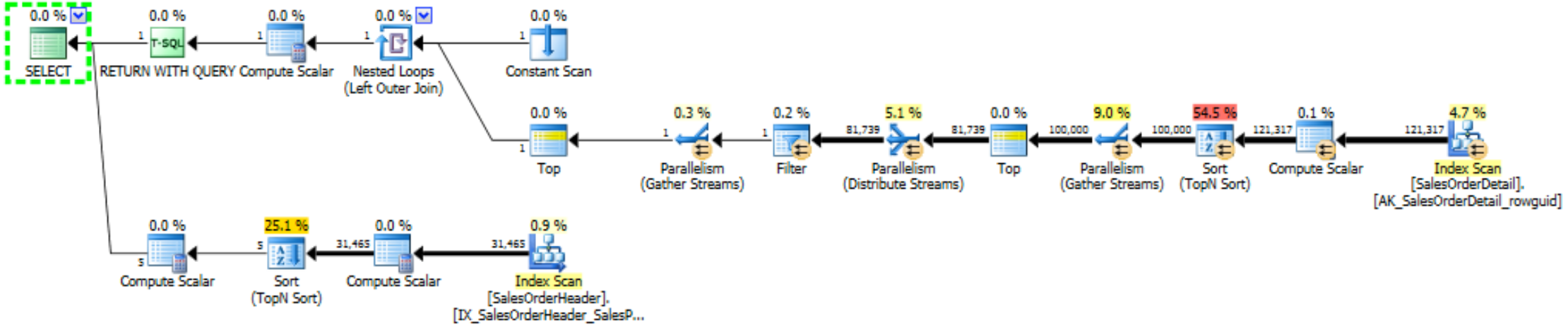
Command Text | Results

Statement	Est Cost	Duration	CPU	Est CPU ...	Reads	Writes	Est IO ...	Est Rows	Actual Ro...
SELECT TOP (5) SalesOrderID, dbo.whatever(SalesOrderID) FROM Sales.SalesOr...	100.0%			100.0%			100.0%	5	
CREATE FUNCTION dbo.whatever(@SalesOrderID INT) RETURNS UNIQUEID...	74.0%			73.4%			86.4%	1	

Text Data

Plan Diagram



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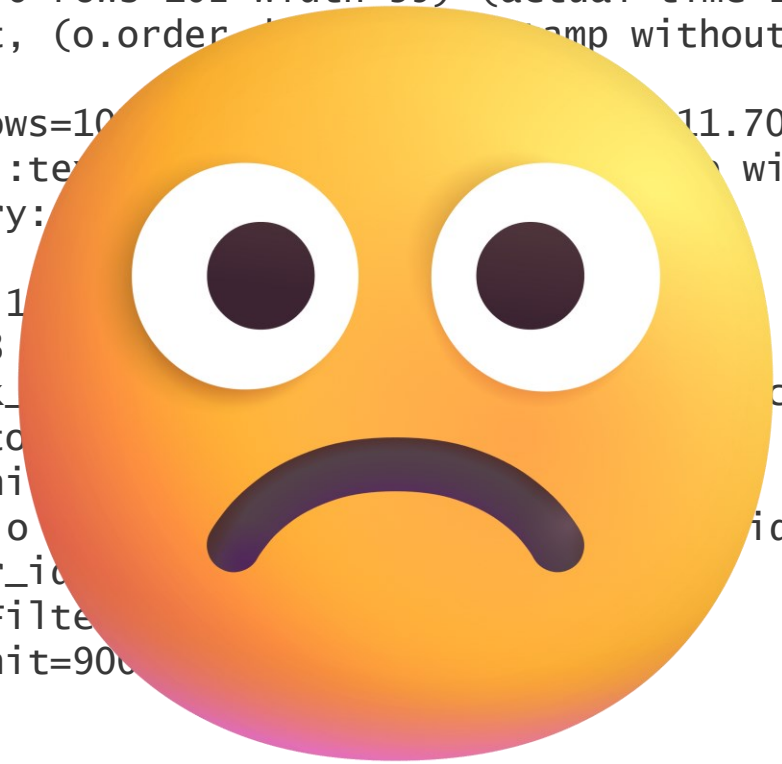
```
GroupAggregate  (cost=1827.91..1830.76 rows=102 width=35) (actual time=11.956..13.754 rows=4 loops=1)
  Group Key: ((date_part('year'::text, (o.order                mp without time zone))::integer), c.custome…
  Buffers: shared hit=903
  ->  Sort  (cost=1827.91..1828.18 rows=10                      11.700..12.686 rows=107 loops=1)
        Sort Key: ((date_part('year'::te                        without time zone))::integer) DESC,…
        Sort Method: quicksort  Memory:
        Buffers: shared hit=903
        ->  Nested Loop  (cost=0.28..1                          time=0.113..10.649 rows=107 loops=1)
              Buffers: shared hit=903
              ->  Index Scan using pk_                          cost=0.28..2.49 rows=1 width=27)
                    Index Cond: (custo
                    Buffers: shared hi
              ->  Seq Scan on orders o                          idth=8) (actual time=0.053..8.413…
                    Filter: (customer_id
                    Rows Removed by Filte
                    Buffers: shared hit=90
Planning Time: 0.267 ms
Execution Time: 13.934 ms
```



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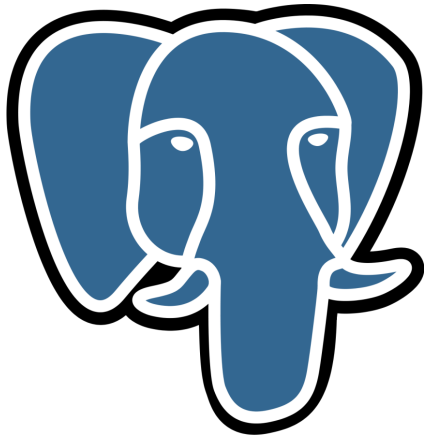
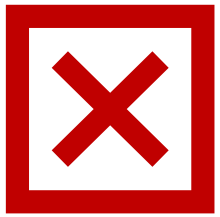
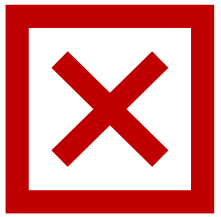
Query Cache and Monitor







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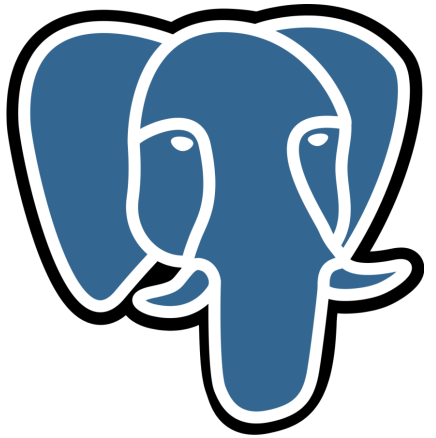
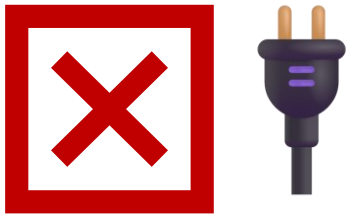
Built-in Job Scheduler





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03/10

PostgreSQL Terminology

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Instance = Cluster

SQL Server

PostgreSQL

User = Role

SQL Server PostgreSQL

Group = Role

SQL Server PostgreSQL

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Transaction Log ≈ Write Ahead Log

SQL Server

PostgreSQL

Row = Row ∈ Tuple

SQL Server PostgreSQL PostgreSQL

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[Table One] = “Table One”

SQL Server

PostgreSQL

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BULK INSERT = COPY

SQL Server

PostgreSQL

TOAST

The Oversized-Attribute Storage Technique

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04/10

Architecture Highlights

PostgreSQL is a heap-based relational database with Multi-version Concurrency Control (MVCC)

MVCC is about concurrency control through transaction isolation levels

Transaction Isolation

- Read Committed
- Repeatable Read
- Serializable Read
- **Read Uncommitted (not supported)**

MVCC at a glance

- Readers don't block writers
- Tuples maintain on-row transaction visibility values (xmin, xmax)
- INSERTS/UPDATES always create new rows
  - Heap-only Tuples (HOT) attempts to mitigate some growth
- Popular MVCC talk:
  https://www.youtube.com/watch?v=gAE_MSQtqnQ

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MVCC at a glance

- Readers don't block writers
- Tuples maintain on-row transaction visibility values (xmin, xmax)
- **INSERTS/UPDATES always create new rows**
  - Heap-only Tuples (HOT) attempts to mitigate some growth
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Extensions

- Must be installed on server
- DBaaS services support different lists
- Added **per-database**
- Per-database impacts backup/restore
  - Extension has to be available on the server
  - Same version must also be available for successful restore

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Extensions

pg_tgrm
(Trigram indexes)

PostGIS
(Geospacial)

HypoPG
(Hypothetical index)

fdw_*
(Foreign data wrapers)

CitusDB
(Horizontal clustering)

ZomboDB
(Elasticsearch index)

TimescaleDB
(Relational time-series)

tablefunc
(Pivot & crosstab)

MORE...

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Extensions

See available extensions

```
SELECT * FROM pg_available_extensions ORDER BY name;
```

Install

```
CREATE EXTENSION timescaledb;
```

Update

```
ALTER EXTENSION timescaledb UPDATE;
```

Uninstall

```
DROP EXTENSION timescaledb;
```

05/10
Getting Connected

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psql

- ≈ **mssql-cli** on steroids
- Cross-platform
- Go-to interface for 90% of community and training
- Bottom line: you should learn at least some basic psql

Resources

- https://psql-tips.org/psql_tips_all.html
- https://tomcam.github.io/postgres/
- http://postgresguide.com/utilities/psql.html

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DBeaver

- Cross-platform, Eclipse (Java) based
- Community and paid license
- Multi-database support
- Most similar feeling to SSMS thus far*

- Supports Postgres
- Notebooks work relatively well
- Postgres still not a first-class citizen, understandably

- Subscription fee with JetBrains
- Lots of great tooling and support
- (Almost) no-brainer if your team uses JetBrains tools

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06/10

Configuration Highlights

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Configuration

- ***Every non-serverless Postgres should be tuned***

Helpful Tuning Resources

https://wiki.postgresql.org/wiki/Tuning_Your_PostgreSQL_Server

https://www.youtube.com/watch?v=IFIXpm73qtk

https://postgresqlco.nf/

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postresql.conf – The big 4

shared_buffers:
- data cache
- at least 25% of total RAM

work_mem:
- max memory for each plan operation
- JOINS, GROUP BY, ORDER BY can all have workers

maintenance_work_mem:
- memory for background tasks like VACUUM and ANALYZE

max_connections:
- exactly as it says

postgresql.conf (other)

wal_compression:
- Off (default)
- Default uses `pglz`
- PG15 can use `lz4` or `zstd`

autovacuum:
- On (default)
- Do not turn off
- 7 ŵùừỂừĝÖń ỂẬ ỂḶÃń ẅÃľ ẅÖľṼĻĝẠỂĝī ẠṇĖ

autoanalyze:
- On (default)
- Do not turn off
- 7 ŵùừỂừĝÖń ỂẬ ỂḶÃń ẅÃľ ẅÖľṼĻĝẠỂĝī ẠṇĖ

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SHOW & SET

- `SHOW` will display the current value
- `SET` allows settings to be modified (when possible)
- Examples:
  - `SHOW ALL;` – page all settings
  - `SHOW max_connections;`–configured connection limit

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Individual Table Auto(vacuum/analyze)

- Autovacuum triggers at 20% data modification
- Autoanalyze triggers at 10% data modification
- Heavy table modifications may require tweaking individual table thresholds
- Analogous to TF-2731, but per table!

Analyze at 5% modification:

```
ALTER TABLE t SET (autovacuum_vacuum_scale_factor=0.05)
```

Analyze threshold above percentage:

```
ALTER TABLE t SET (autovacuum_vacuum_threshold=500)
```

'If you think auto(vacuum/analyze) is running too frequently, it's probably not running frequently enough'

07/10

Create, Backup, and Restore

Create

- Default database = **postgres**
- Template database = **template1** ≈ **MODEL**
- “Super secret” template = **template0**
- Creating a database will use **template1** by default
  - If you want specific extensions, users, permissions, schemas – modify this template

Create database (with template1)

```
CREATE DATABASE myDB;
```

Backup

- **pg_basebackup for cluster-wide, PITR (with WAL backup)**
- **pg_dump** for *regular* backups
- Can be text-based (SQL script) or archive (binary)
- Only directory archives can be parallelized
- **CREATE EXTENSION** commands saved, but not versions

```
pg_dump -U postgres –Fc -d postgres -h localhost  -f test.dump
```

-U = username **-Fc** = format (directory | custom | tar) **-d** = database name

-h = host **-j** = number of parallel jobs **-f** = filename

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Restore

- **Must always** have a clean database for a fresh restore
  - The `--create` option doesn't do what you think
- To restore to a new name, empty database must be created
- Only directory archives can be restored in parallel

```
pg_restore -d test_restore -Fc test.dump -U postgres -h localhost
```

-U = username **-Fc** = format (directory | custom | tar)

-h = host **-d** = target database

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SQL Differences

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Data Type Differences

SQL Server	PostgreSQL
BIT	BOOLEAN
VARCHAR/NVARCHAR	TEXT
DATETIME/DATETIME2	TIMESTAMP (kind of)
DATETIMEOFFSET	TIMESTAMP WITH TIME ZONE
UUID	CHAR(16), `uuid-ossp` extension, PG14
VARBINARY	BYTEA

🔥 ARRAY, RANGE, ENUM, GEOM 🔥

Case Rules

- Case sensitive string comparison (LIKE/ILIKE)
- All object names are coerced to lower case
- "Double quote" to qualify names
- Prefer `lower_snake_case`

Case Rules

SQL Server

```
SELECT [Name]
  FROM [Purchasing].[Vendor]
 WHERE BusinessEntityID = 1492
```

Postgres

```
SELECT “Name”
  FROM “Purchasing”.“Vendor”
 WHERE “BusinessEntityID” = 1492;
```

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Case Rules

SQL Server

```
SELECT [Name]
  FROM [Purchasing].[Vendor]
 WHERE BusinessEntityID = 1492
```

Postgres

```
SELECT name
  FROM purchasing.vendor
 WHERE business_entity_id = 1492;
```

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LIMIT ≈ TOP

SQL Server

```
SELECT TOP(10) *
  FROM [Purchasing].[Vendor]
```

Postgres

```
SELECT *
  FROM purchasing.vendor
  LIMIT 10;
```

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LIMIT/OFFSET ≈ OFFSET/FETCH

SQL Server

```
SELECT *
  FROM [Purchasing].[Vendor]
ORDER BY name
OFFSET 10 ROWS
FETCH 10 ROWS ONLY
```

Postgres

```
SELECT *
  FROM purchasing.vendor
ORDER BY name
LIMIT 10 OFFSET 10;
```

ORDER/GROUP BY

SQL Server

```
SELECT SUBSTRING(name,1,1) nameCohort, SUM(amount) totalSales
  FROM [Purchasing].[Sales]
GROUP BY SUBSTRING(name,1,1)
ORDER BY nameCohort, SUM(amount)
```

Postgres

```
SELECT SUBSTRING(name,1,1) name_cohort, SUM(amount) total_sales
  FROM purchasing.sales
GROUP BY name_cohort
ORDER BY name_cohort, total_sales;
```

ORDER/GROUP BY

SQL Server

```
SELECT SUBSTRING(name,1,1) nameCohort, SUM(amount) totalSales
  FROM [Purchasing].[Sales]
GROUP BY SUBSTRING(name,1,1)
ORDER BY nameCohort, SUM(amount)
```

Postgres

```
SELECT SUBSTRING(name,1,1) name_cohort, SUM(amount) total_sales
  FROM purchasing.sales
GROUP BY 1
ORDER BY 1, 2;
```

DAY/MONTH/YEAR() ≈ DATE_PART()

SQL Server

```
SELECT COUNT(*), YEAR(OrderDate)
FROM Sales.Invoices
GROUP BY YEAR(OrderDate)
ORDER BY YEAR(OrderDate) DESC
```

Postgres

```
SELECT COUNT(*), DATE_PART('year',order_date) order_year
FROM sales.invoices
GROUP BY order_year
ORDER BY order_year DESC;
```

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GETDATE() ≈ NOW()

SQL Server

```
SELECT SYSDATETIME();
```

Postgres

```
SELECT now();
```

Date Math & Intervals

SQL Server

```
SELECT COUNT(*), YEAR(OrderDate)
FROM Sales.Invoices
WHERE OrderDate > DATEADD(MONTH,-1,SYSDATETIME())
GROUP BY YEAR(OrderDate)
```

Postgres

```
SELECT COUNT(*), DATE_PART('year',order_date) order_year
FROM sales.invoices
WHERE order_date > NOW() - INTERVAL '1 MONTH'
GROUP BY order_year;
```

LATERAL ≈ APPLY

- CROSS/OUTER APPLY in T-SQL
  - Often used as an “optimization fence”
  - Outer query iterates an inner query
  - Helpful when JOIN isn’t possible
  - Retrieve top ordered row for each item in a list (ie. “most recent value for each item”)
  - Iterating a function that references the outer query
- LATERAL JOIN allows the similar functionality

LATERAL ≈ APPLY

SQL Server

```
SELECT id, name, dayMonth, total
  FROM Vendor v1
CROSS APPLY (
  SELECT TOP(1) dayMonth, SUM(amount) total
  FROM Sales
  WHERE customerID = v1.id
  GROUP BY dayMonth
  ORDER BY SUM(amount) DESC
) s1
```

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LATERAL ≈ APPLY

Postgres

```
SELECT id, name, day_month, total
  FROM vendor v1
INNER JOIN LATERAL (
  SELECT day_month, SUM(amount) total
  FROM sales
  WHERE customer_id = v1.id
  GROUP BY day_month
  ORDER BY total DESC
  LIMIT 1
) on true s1;
```

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Anonymous Code blocks

- Default query language is SQL
- Does not support anonymous code blocks
  - Variables
  - Loops
  - T-SQL like features
- Requires DO blocks, Functions, or SPROCs
  - Default language is pl/pgsql ≈ T-SQL

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Inline T-SQL vs pl/pgsql

SQL Server

```
DECLARE @PurchaseName AS NVARCHAR(50)
SELECT @PurchaseName = [Name]
  FROM [Purchasing].[Vendor]
  WHERE BusinessEntityID = 1492
PRINT @PurchaseName
```

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Inline T-SQL vs pl/pgsql

Postgres

```
DO $$
  DECLARE purchase_name TEXT;
BEGIN
  SELECT name
  FROM purchasing.vendor
  WHERE business_entity_id = 1492 INTO purchase_name;

  RAISE NOTICE '%', purchase_name;
END;
$$
```

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Functions

SQL Server

- Scaler
- Inline Table Valued
- Multi-statement Table Valued
- No tuning hints for query planner
- TSQL Only

Postgres

- Scaler
- Table/Set Types
- Triggers
- Query planner tuning parameters
- Any procedural language, but typically PL/pgSQL

Stored Procedures

SQL Server

- Complex logic
- Multi-language
- Contained in calling transaction scope
- With some work, can return results

Postgres

- Complex logic
- Multi-language
- Can issue COMMIT/ROLLBACK and keep processing
- Can return a single INOUT value
- Introduced in PostgreSQL 11

Triggers

- Functions applied to tables
- INSERT/UPDATE/DELETE
- BEFORE/AFTER/INSTEAD OF
- ROW and STATEMENT
- Conditional
- NEW and OLD internal variables
- …Reusable across tables!

Create Trigger Function

Postgres

```
CREATE OR REPLACE FUNCTION user_log()
RETURNS TRIGGER AS
$BODY$
BEGIN
  INSERT INTO UserLog (Username, Message) VALUES (NEW.Username, NEW.Message)
END;
$BODY$
LANGUAGE plpgsql;
```

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Apply Trigger

Postgres

```
CREATE TRIGGER tu_users
AFTER UPDATE
ON Users
FOR EACH ROW
WHEN (OLD.FirstName IS DISTINCT FROM NEW.FirstName)
EXECUTE PROCEDURE user_log();
```


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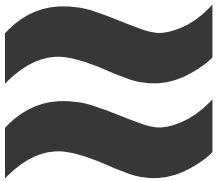
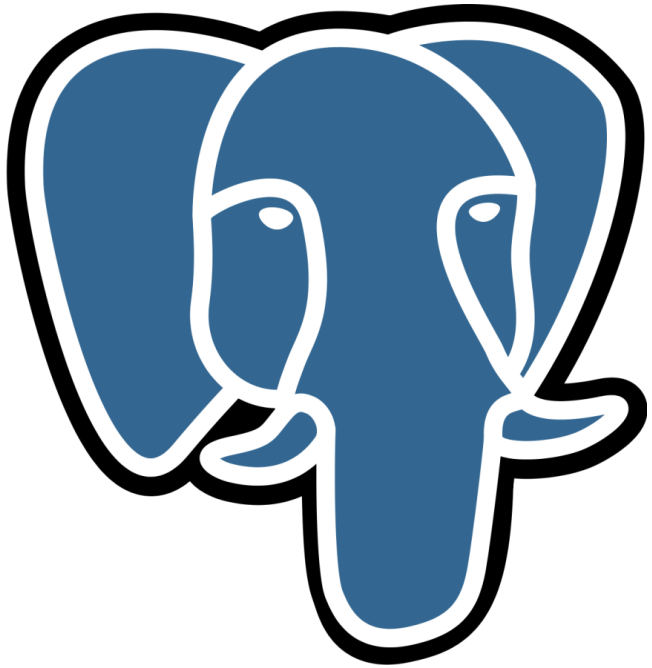
SQL Server®


ORACLE®



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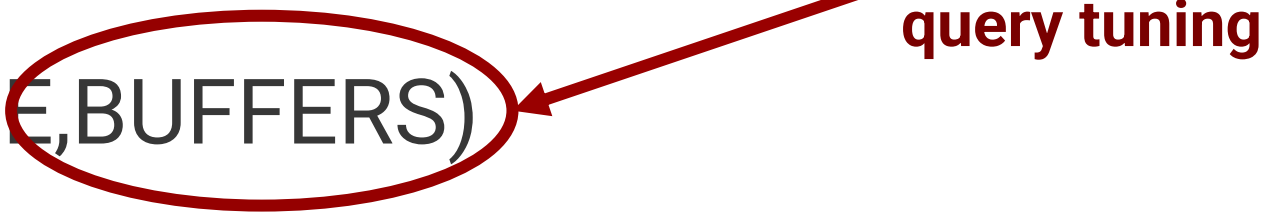
Query Tuning

EXPLAIN in Practice

- EXPLAIN = Estimated plan
- EXPLAIN ANALYZE = Actual plan
- EXPLAIN (ANALYZE,BUFFERS)
  - Query plan with disk IO
- EXPLAIN (ANALYZE,BUFFERS,VERBOSE)
  - Additional details on columns, schemas, etc.



EXPLAIN

- Inverted tree representation
- There is no built-in visual execution plan
- EXPLAIN provides textual plan
  - pgAdmin does do some visualization
- Websites for visualizations and suggestions
  - https://www.pgmustard.com/
  - https://explain.depesz.com/

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Reading EXPLAIN

--> Nodes

Read inside-out

Join/Aggregate/Merge/Append at each level

```
EXPLAIN (ANALYZE, BUFFERS)
SELECT customer_name, count(*), date_part('year',order_date)::int order_year
FROM sales.orders o
 INNER JOIN sales.customers c ON o.customer_id=c.customer_id
WHERE c.customer_id=100
GROUP BY customer_name,order_year
ORDER BY order_year DESC;
```

```
GroupAggregate  (cost=1827.91..1830.76 rows=102 width=35) (actual time=11.956..13.754 rows=4 loops=1)
 Group Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer), c.customer_name
 Buffers: shared hit=903
 ->  Sort  (cost=1827.91..1828.18 rows=107 width=27) (actual time=11.700..12.686 rows=107 loops=1)
     Sort Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer) DESC, c.customer_name
     Sort Method: quicksort  Memory: 33kB
     Buffers: shared hit=903
     ->  Nested Loop  (cost=0.28..1824.30 rows=107 width=27) (actual time=0.113..10.649 rows=107 loops=1)
         Buffers: shared hit=903
         ->  Index Scan using pk_sales_customers on customers c  (cost=0.28..2.49 rows=1 width=27)
             Index Cond: (customer_id = 100)
             Buffers: shared hit=3
         ->  Seq Scan on orders o  (cost=0.00..1819.94 rows=107 width=8) (actual time=0.053..8.413 rows=107 loops=1)
             Filter: (customer_id = 100)
             Rows Removed by Filter: 73488
             Buffers: shared hit=900
Planning Time: 0.267 ms
Execution Time: 13.934 ms
```

```
GroupAggregate  (cost=1827.91..1830.76 rows=102 width=35) (actual time=11.956..13.754 rows=4 loops=1)
 Group Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer), c.customer_name
 Buffers: shared hit=903
 ->  Sort  (cost=1827.91..1828.18 rows=107 width=27) (actual time=11.700..12.686 rows=107 loops=1)
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Planning Time: 0.267 ms
Execution Time: 13.934 ms
```

GroupAggregate (cost=1827.91..1830.76 rows=102 width=35)
(actual time=11.956..13.754 rows=4 loops=1)

Estimate vs. Actual

Group Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer), c.customer_name

Buffers: shared hit=903

Total 8kb Pages –
"Shared"= Memory/"Read" = Disk

-> Sort (cost=1827.91..1828.18 rows=107 width=27) (actual time=11.700..

Sort Key: ((date_part('year'::text, (o.order_date)::timestamp without

Sort Method: quicksort Memory: 33kB

Memory or External Disk Sort?

Buffers: shared hit=903

-> Nested Loop (cost=0.28..1824.30 rows=107 width=27) (actual time=0.113..10.

Buffers: shared hit=903

-> Index Scan using pk_sales_customers on customers c (cost=0.28..2.49 rows=1 width=27)

Index Cond: (customer_id = 100)

Buffers: shared hit=3

-> Seq Scan on orders o (cost=0.00..1819.94 rows=107 width=8) (actual time=0.053..8.413 rows=107 loops=1)

Seq = All Rows from table

Filter: (customer_id = 100)

Rows Removed by Filter: 73488

Buffers: shared hit=900

Planning Time: 0.267 ms

High Planning Time?

Execution Time: 13.934 ms

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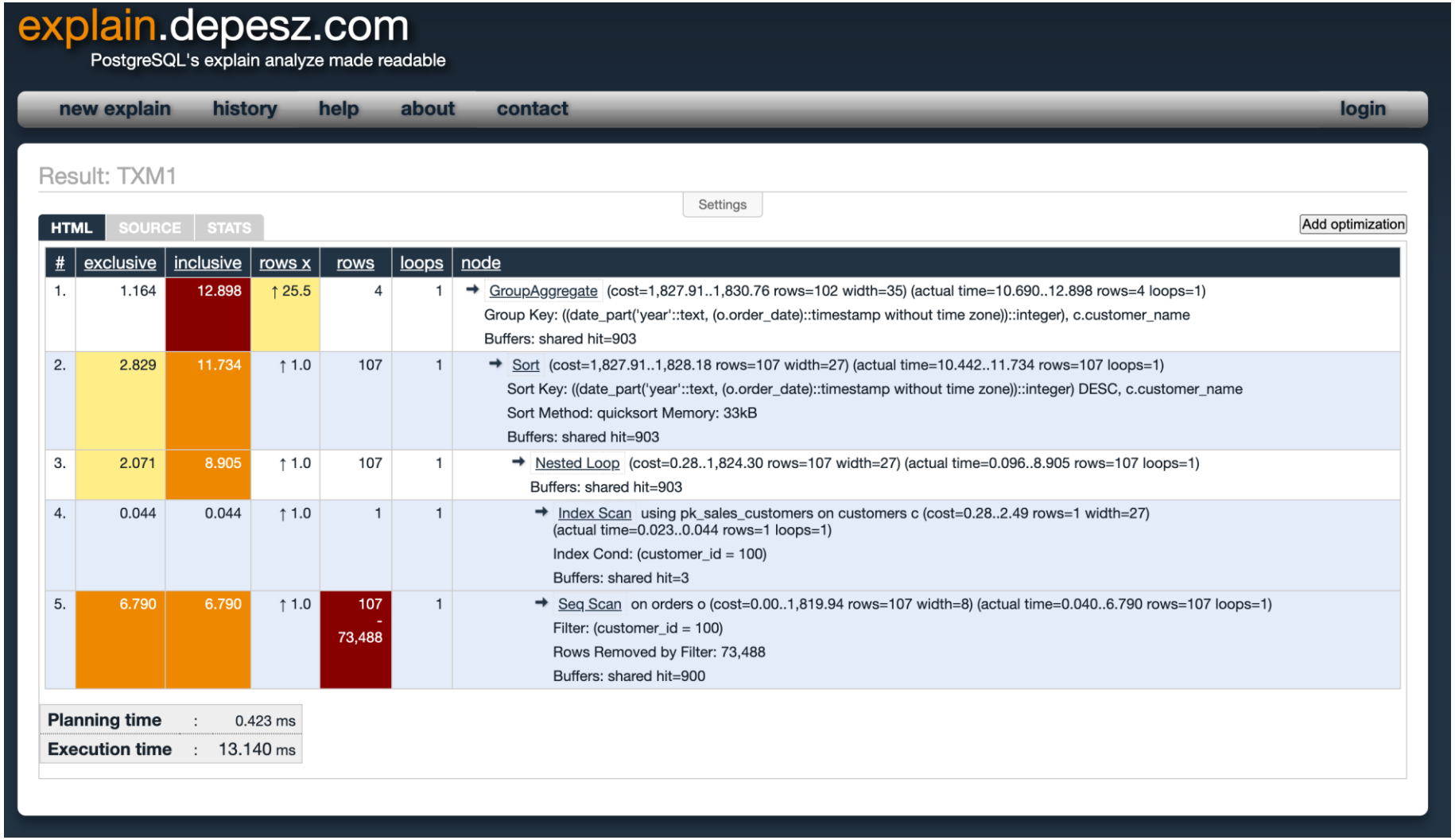
explain.depesz.com
PostgreSQL's explain analyze made readable
new explain
history
help
about
contact
login
Result: TXM1
Settings
HTML
SOURCE
STATS
Add optimization
exclusive inclusive rows x rows loops node
1. 1.164 12.898 ↑ 25.5 4 1 GroupAggregate (cost=1,827.91..1,830.76 rows=102 width=35) (actual time=10.690..12.898 rows=4 loops=1)
Group Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer), c.customer_name
Buffers: shared hit=903
2. 2.829 11.734 ↑ 1.0 107 1 Sort (cost=1,827.91..1,828.18 rows=107 width=27) (actual time=10.442..11.734 rows=107 loops=1)
Sort Key: ((date_part('year'::text, (o.order_date)::timestamp without time zone))::integer) DESC, c.customer_name
Sort Method: quicksort Memory: 33kB
Buffers: shared hit=903
3. 2.071 8.905 ↑ 1.0 107 1 Nested Loop (cost=0.28..1,824.30 rows=107 width=27) (actual time=0.096..8.905 rows=107 loops=1)
Buffers: shared hit=903
4. 0.044 0.044 ↑ 1.0 1 1 Index Scan using pk_sales_customers on customers c (cost=0.28..2.49 rows=1 width=27)
(actual time=0.023..0.044 rows=1 loops=1)
Index Cond: (customer_id = 100)
Buffers: shared hit=3
5. 6.790 6.790 ↑ 1.0 107 - 73,488 1 Seq Scan on orders o (cost=0.00..1,819.94 rows=107 width=8) (actual time=0.040..6.790 rows=107 loops=1)
Filter: (customer_id = 100)
Rows Removed by Filter: 73,488
Buffers: shared hit=900
Planning time : 0.423 ms
Execution time : 13.140 ms

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pg_stat_statement

- MUST HAVE Extension for query analysis
- Installed in all/most DBaaS offerings
- Does not save plans or provide recommendations
- Allows you to do triage: “Is this a big query issue, or death by 1,000 small cuts?”

pg_stat_statement: total time w/ cache hit ratio

```
SELECT query, calls, total_time, rows,
            100.0 * shared_blks_hit/nullif(shared_blks_hit + shared_blks_read, 0)
            AS hit_percent
FROM pg_stat_statements
ORDER BY total_time DESC
LIMIT 5;
```

```
-[ RECORD 1 ]---------------------------------------------------------------
query          | SELECT * FROM sales.orders where customer_id = ?
calls          | 1000
total_time     | 2451.00000000000
Rows.          | 521
hit_percent    | 99.9873421
```

*Lots of good videos/tutorials, but also see the docs for more help and ideas.

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pg_stat_statement

- Statistics are cumulative 😟
- Use third party tools to help you monitor
- Install CRON extensions and query metrics periodically

Point-in-time metrics example: https://www.youtube.com/watch?v=wTmKGyiqoCk

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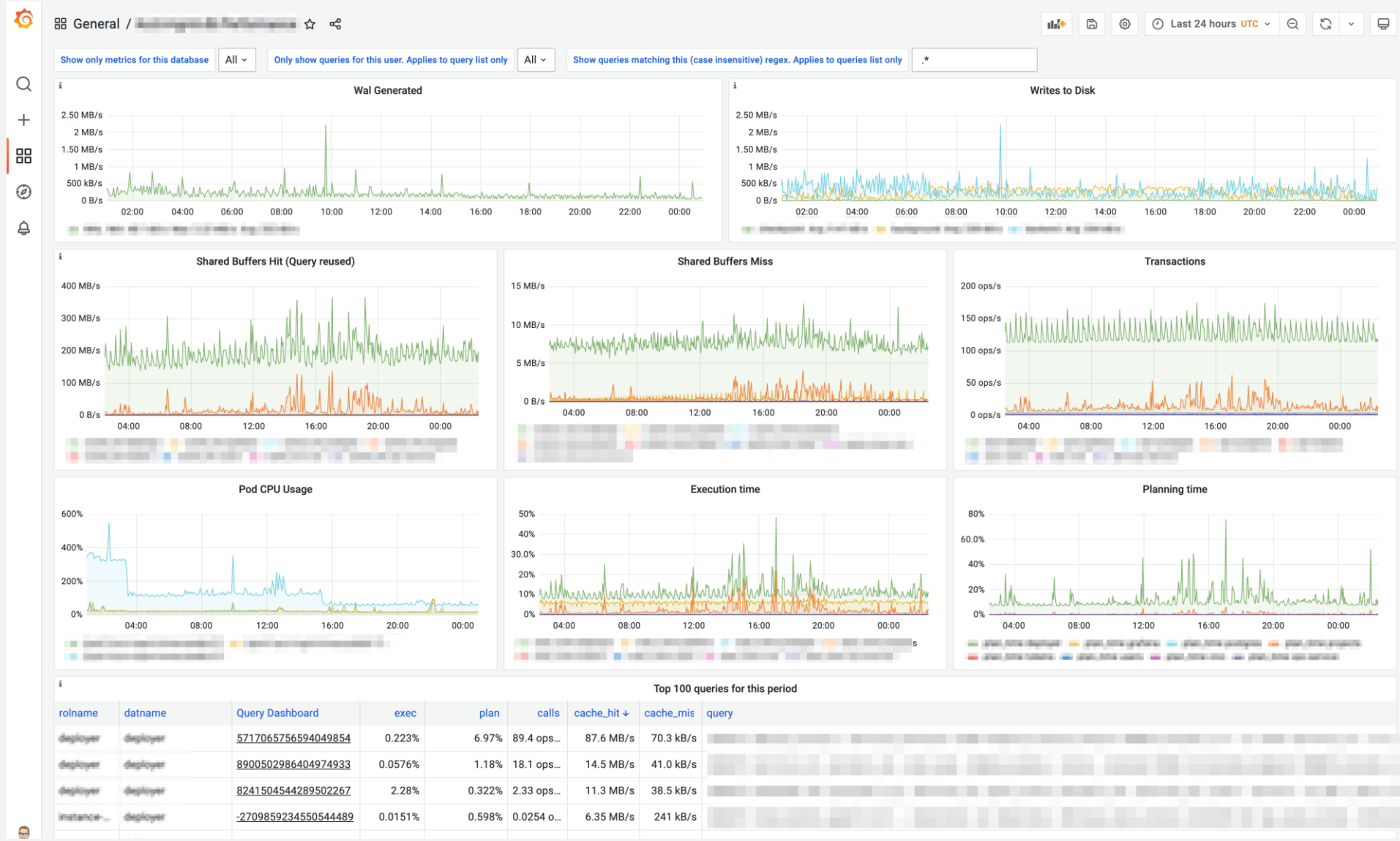
General /
Show only metrics for this database
All
Only show queries for this user. Applies to query list only
All
Show queries matching this (case insensitive) regex. Applies to queries list only
.*
Last 24 hours UTC
Wal Generated
2.50 MB/s
2 MB/s
1.50 MB/s
1 MB/s
500 kB/s
0 B/s
02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 00:00
Writes to Disk
2.50 MB/s
2 MB/s
1.50 MB/s
1 MB/s
500 kB/s
0 B/s
02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 00:00
Shared Buffers Hit (Query reused)
400 MB/s
300 MB/s
200 MB/s
100 MB/s
0 B/s
04:00 08:00 12:00 16:00 20:00 00:00
Shared Buffers Miss
15 MB/s
10 MB/s
5 MB/s
0 B/s
04:00 08:00 12:00 16:00 20:00 00:00
Transactions
200 ops/s
150 ops/s
100 ops/s
50 ops/s
0 ops/s
04:00 08:00 12:00 16:00 20:00 00:00
Pod CPU Usage
600%
400%
200%
0%
04:00 08:00 12:00 16:00 20:00 00:00
Execution time
50%
40%
30.0%
20%
10%
0%
04:00 08:00 12:00 16:00 20:00 00:00
Planning time
80%
60.0%
40%
20%
0%
04:00 08:00 12:00 16:00 20:00 00:00
Top 100 queries for this period
rolname datname Query Dashboard exec plan calls cache_hit ↓ cache_mis query
5717065756594049854 0.223% 6.97% 89.4 ops... 87.6 MB/s 70.3 kB/s
8900502986404974933 0.0576% 1.18% 18.1 ops... 14.5 MB/s 41.0 kB/s
8241504544289502267 2.28% 0.322% 2.33 ops... 11.3 MB/s 38.5 kB/s
-2709859234550544489 0.0151% 0.598% 0.0254 o... 6.35 MB/s 241 kB/s

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Help and Community

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Community & Help

- Postgres Slack
- X (#postgres, #postgresql, #pghelp)
- StackOverflow (dba.stackexchange.com)
- Planet Postgres (blog aggregator)
- Mailing lists (postgresql.org/list)
- PostgreSQL Docs (postgresql.org/docs)

Community & Help

- Redgate PostgreSQL 101 Series
- Postgres Weekly (Cooper Press)
- Postgres.fm Podcast

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Books and Courses

- The Art of PostgreSQL
- PostgreSQL Query Optimization (Apress)
- A Curious Moon (Rob Conery)

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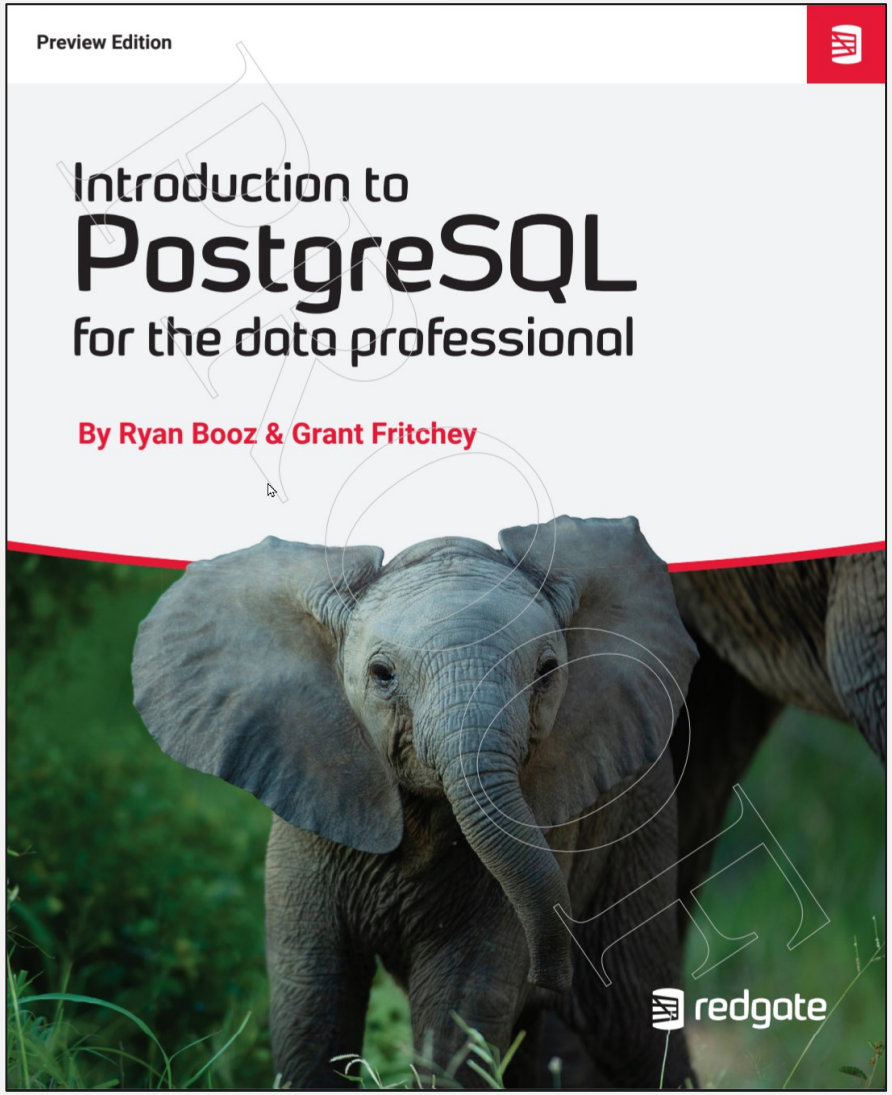
PostgreSQL at PASS Data Community Summit!

- PostgreSQL Fundamentals pre-con on Tues. Nov. 5
- 20+ PostgreSQL sessions
- Co-hosted Postgres Conference Seattle 2024
  - 2 days
  - 3 tracks
  - 24 sessions

We wrote a book!!



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What Questions do you have?

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🎉 THANK YOU! 🎉

github.com/ryanbooz/presentations

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