

# The Accidental DBA

*a guide for  
the perplexed*



# AWS Instances

(for people not running Docker/vagrant)

- 1) log in to your instance
- 2) do “start\_adba\_container.sh”

# covered in this talk

- installation
- extensions
- updates and upgrades
- configuration
- basic replication
- connections & security
- backups
- VACUUM
- query management

# not covered

- older versions (< 9.1)
  - older PostGIS (< 2.0)
- schema design
- query rewriting
- indexes
- testing
- application stuff

# Exercises & Slides

- <https://github.com/pgexperts/accidentalDBA>
- [accidentalDBA/tutorial/exercises.txt](#)
- exercises are Docker container or Vagrant VM
  - you needed to install this before you got here

**“You know Linux,  
right?  
You're in charge  
of the database  
now.”**

**“Efficiency”**

**“DevOps”**

**“Cloud”**

**“Growth Opportunity”**

**“We're not going to  
hire a DBA”**



# Y U no DBA?

- 1.limited budgets
- 2.shortage of operational staff
- 3.cheaper OSS databases

... you are the DBA now.

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## PostgreSQL 9.2.4 Documentation

### The PostgreSQL Global Development Group

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**Oh My God,  
We're All Going To Die.**









# up now

```
cd /dir/to/accidentalDBA/vagrant/  
vagrant up
```

or:

```
docker run -e TERM -it \  
jberkus/AccidentalDBA
```



# Installation



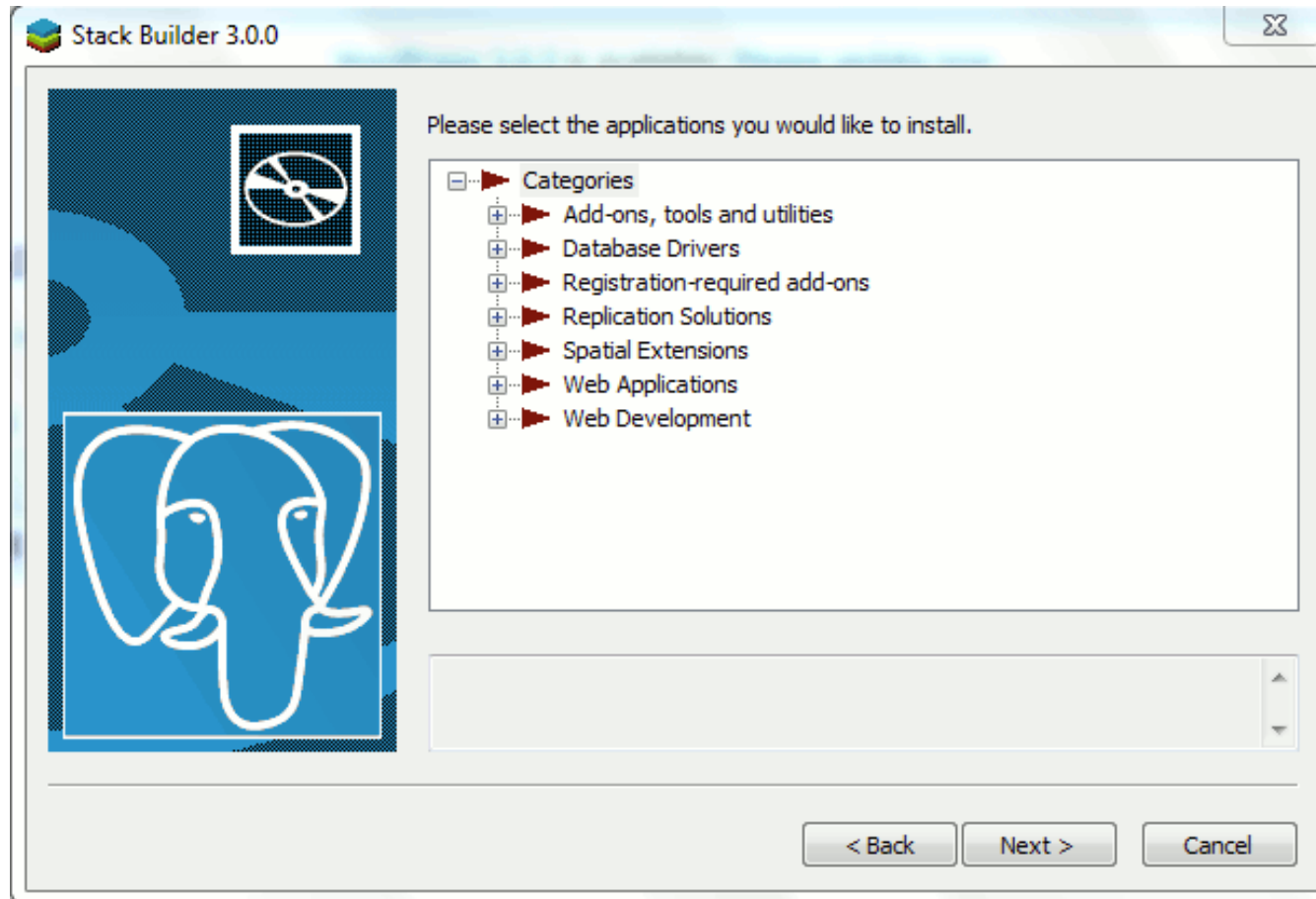
# Linux: use packages!

- version not important?
- use the ones that come with your distro
  - Red Hat, Centos, SciLinux
  - Debian, Ubuntu
  - SuSE

# Linux: use packages!

- need the latest version?
- alternate packages
  - Red Hat: [yum.postgresql.org](http://yum.postgresql.org)
  - Ubuntu: [apt.postgresql.org](http://apt.postgresql.org)
  - SuSE: build service
  - Debian: [apt.postgresql.org](http://apt.postgresql.org)

# Windows/OSX



# Windows/OSX

- use the graphical installer
  - from EnterpriseDB
  - “wizard” GUI
- also installs optional components
  - pgAdmin
  - Some extensions

# other platforms

- Packages available:
  - Solaris 10/11
  - OpenSolaris/Illumos
  - FreeBSD
  - OpenBSD
  - NetBSD
- No Packages:
  - HP-UX
  - AIX
  - Solaris 9
  - Tablets
  - “Home” Windows

# get logged in

```
vagrant ssh
```

```
sudo su -
```

```
tmux
```

# packages exercise

```
less  
/etc/apt/sources.list.d/pgdg.list  
apt-cache search postgresql  
apt-cache search postgis
```

# create data directory

- \$PGDATA is where the database files live
- most packages create it
- if not, use “initdb” to create it
  - pick a suitable location!

```
initdb -D /db/9.3/main
```





**superuser**

# superuser

- has the privilege “superuser”
- usually owns the PGDATA dir
- usually “postgres”
  - but not always
- can have more than one
- cannot be secured

# initdb exercise

```
su - postgres  
mkdir test  
initdb -D test  
cd test  
ls -l  
exit
```



**starting & stopping**

# 3 commands

service / initdb scripts

- normal use, recommended

pg\_ctl

- for custom configurations
- must be run as “postgres”

postgres

- only for control script-writers



# 4 states

1. start
2. stop
3. restart
4. reload

# start & stop

- what it says on the tin
- except ...
  - “smart” stop: wait for all connections
  - “fast” stop: force disconnect
  - “immediate” stop: just like “kill”



# restart

- shuts down and restarts postgres
- breaks all connections
- required for:
  - changes to memory, connections
  - changes to archive\_mode
  - changes to logging\_collector

# reload

- signals the postmaster to reload files
- does not break connections
- works for
  - changes to security (pg\_hba.conf)
  - most changes to logging
  - changes to defaults

# start/stop exercise

```
service postgresql start
```

```
service postgresql restart
```

```
service postgresql reload
```

```
service postgresql stop
```

# start/stop exercise

```
su - postgres
```

```
pg_ctl -D /etc/postgresql/9.4/main  
start
```

```
pg_ctl -D /etc/postgresql/9.4/main  
-m fast stop
```

```
exit
```

# start/stop exercise

```
cd /etc/postgresql/9.4/main/  
EDITOR postgresql.conf  
service postgresql start  
less  
/var/log/postgresql/postgresql-  
{DOW}.log
```

# start/stop exercise

```
EDITOR postgresql.conf  
service postgresql start  
less  
/var/log/postgresql/postgresq  
l-{DOW}.log
```

```
Sidney-Stratton:~ josh$ psql libdata
psql (9.1.1)
Type "help" for help.
```

```
libdata=# \dt
```

List of relations

| Schema | Name         | Type  | Owner   |
|--------|--------------|-------|---------|
| public | books        | table | libdata |
| public | branches     | table | libdata |
| public | copies       | table | libdata |
| public | copy_history | table | libdata |
| public | copy_status  | table | libdata |

**the psql  
command line**

# pgAdmin

The screenshot displays the pgAdmin 3 interface. The Object browser on the left shows a tree structure of server groups, including 'serveur 1 (localhost:5432)' which contains databases 'b1', 'b2', and 'benchs'. The 'benchs' database is selected, showing its catalogs, casts, and languages. The Properties tab for the 'pgbench\_accounts' table is open, displaying various attributes like Name, OID, Owner, Tablespace, ACL, Of type, Primary key, Rows (estimated), Fill factor, Rows (counted), and Inherits tables.

The SQL Editor window shows a query: `select * from pg_stat_activity`. The Output pane displays the results of this query in a table format.

The Properties dialog for the 'pgbench\_accounts' table is also open, showing fields for Name, OID, Owner, Tablespace, Of type, Fill Factor, Has OIDs, and Comment. The 'Name' field is highlighted.

|   | datid<br>oid | datname<br>name | procpid<br>integer | usesysid<br>oid | username<br>name | application_name<br>text | client_addr<br>inet | client_port<br>integer | back_time |
|---|--------------|-----------------|--------------------|-----------------|------------------|--------------------------|---------------------|------------------------|-----------|
| 1 | 11874        | postgres        | 12482              | 10              | guillaume        |                          | :::1                | 49467                  | 2010      |
| 2 | 33018        | b1              | 12483              | 10              | guillaume        |                          | :::1                | 49468                  | 2010      |
| 3 | 16384        | benchs          | 12485              | 10              | guillaume        |                          | :::1                | 49469                  | 2010      |
| 4 | 16384        | benchs          | 12490              | 10              | guillaume        |                          | :::1                | 49470                  | 2010      |



# psql exercise

```
su - postgres
```

```
psql libdata
```

```
\?
```

```
\h create table
```

```
\dt
```

```
\d+ copies
```



**extensions**

# extensions?

- extensions add extra functionality
  - like Python/Perl modules, Ruby Gems, etc.
- need to be installed separately
  - some come with PostgreSQL packages
  - some need to be installed from PGXN or source
- handled very differently before 9.1

# libdata extensions

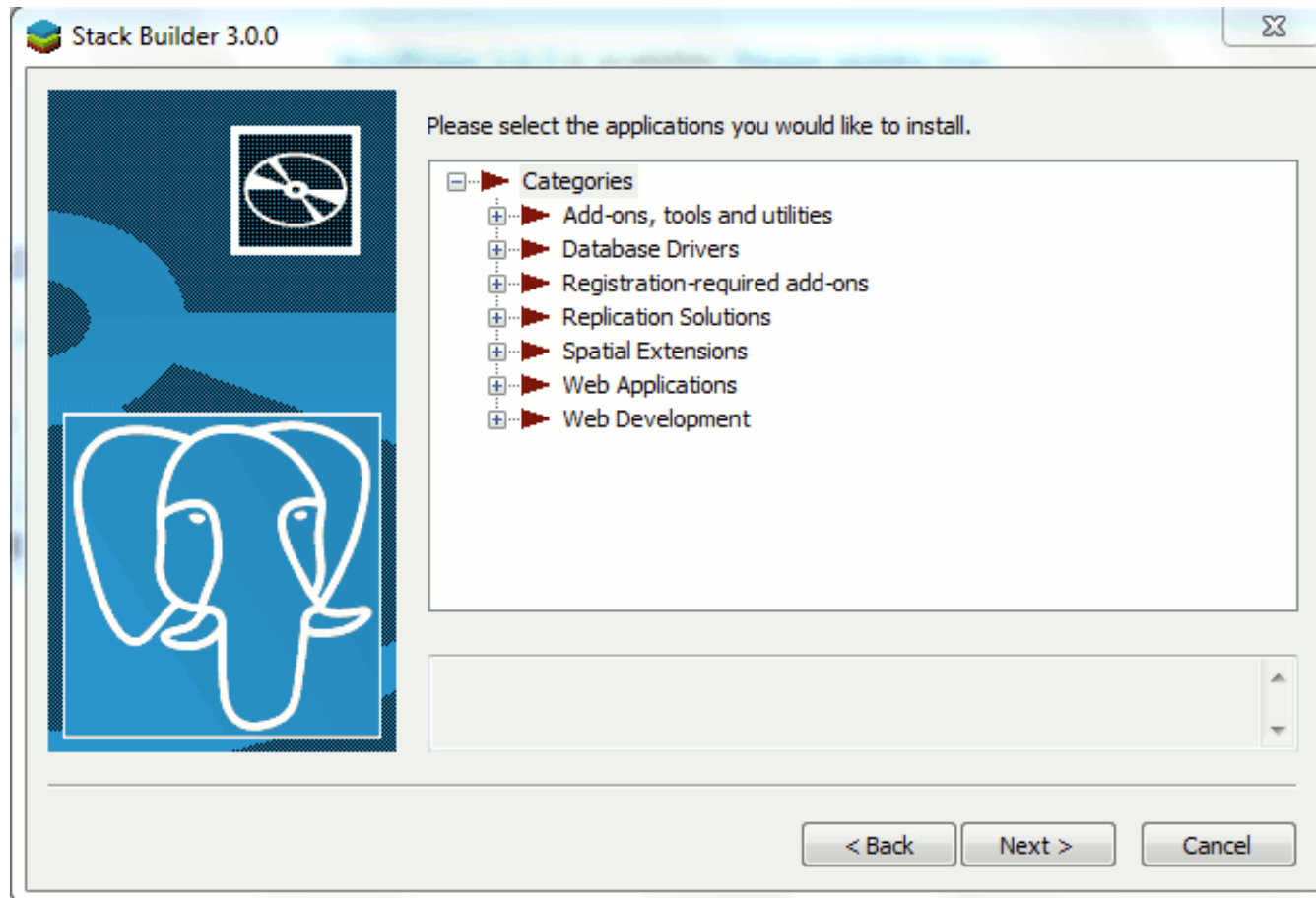
| Extension | Purpose  | Source  |
|-----------|--|---------|
| plpgsql   | <i>Procedural language for triggers and functions. Automatically included 9.0 and later.</i> | core    |
| citext    | <i>Case-insensitive text data type</i>   | contrib |
| isn       | <i>Product scan code data type. Used in libdata for ISBNs</i>                                | contrib |
|           |  |         |

# installing extensions

1. install the binary files
  - using packages, PGXN, or source
  - installs to postgres “share” directory
  - a few extensions don't have binaries
2. install the extension in each database where it's used

# Mac/Windows

- EnterpriseDB installer



# extensions exercise

```
\dx
```

```
create extension hstore;
```

```
select * from pg_extension;
```

```
select 'fname => josh,  
       lname => berkus'::hstore;
```

# extensions exercise

```
\c libdata
```

```
\dx
```

```
alter extension citext  
update;
```





**updates  
&  
upgrades**

🏠 [InfoWorld Home](#) / [Security](#) / [News](#) / PostgreSQL updates address high-risk...

APRIL 05, 2013

# PostgreSQL updates address high-risk vulnerability, other issues

**VMware also releases fixes for its PostgreSQL-based vFabric Postgres database product**

By Lucian Constantin | IDG News Service

 [Print](#) |  [Add a comment](#)



3



More

The PostgreSQL developers released updates for all major branches of the popular open-source database system on Thursday in order to address several vulnerabilities, including a high-risk one that could allow attackers to crash the server, modify

# major vs. minor

**9.4** == a major version

- requires an *upgrade* from 9.2.8
- contains features not in 9.2
- requires testing and planned downtime

**9.4.5** == a minor version

- is a minor *update* from 9.3.4.
- can (and should) be applied immediately

# minor updates

- come out ~~ every 2 months
- contain only bugfixes
  - security hole patches
  - data loss prevention
  - fix server crashes
- no new or changed features
  - *occasional* documented breakage

**update promptly**  
**update often**

# update procedure

- 1.schedule 5 minute downtime
- 2.download packages
- 3.shut down postgresql
- 4.install packages
- 5.restart postgresql
- 6.restart application

# major upgrades

- come out once per year
- have many new features
  - and sometimes break stuff which used to work
- require extensive testing with your application
- require significant downtime to upgrade

# upgrade procedures

- dump & reload
  - use pg\_dump & pg\_restore on database
  - most reliable way
  - “cleans up” database in process
  - best with small databases
  - can take a long, long time



# upgrade procedures

- pg\_upgrade
  - upgrade “in place”
  - much faster
  - does not “clean up” database
  - sometimes doesn't work
    - issues with extensions

**EOL after  
5 years**

# upgrading extensions

*not possible before 9.1*

1. upgrade Postgres (or not)
2. install new extension binaries
3. run upgrade script in each DB

```
ALTER EXTENSION postgis  
UPDATE;
```



**configuration**

# configuration

1. Hardware
2. OS/FS
3. PostgreSQL

# use good hardware

- databases use *all* the hardware
  - RAM, CPU, IO
  - disk can be very important
    - DB larger than RAM
    - write-heavy database
  - PostGIS requires lots of RAM + CPU

*the database cannot outperform bad hardware*

**put the database  
on its own server  
(or virtual server)**

# cloud servers

- cloud server performance sucks
  - especially IO
- AWS tip: make sure you have enough RAM to cache the *whole* database
  - or pay for lots of IOPS



# Linux configuration

1. turn the OOM killer off
2. turn reclaim\_zone\_files off
3. use XFS or Ext4 for database files
  1. use “noatime,nodiratime”
4. increase shmmax, shmall
  1. so that you can raise shared\_buffers
  2. *only required before 9.3*

# tmux new window

```
<ctrl>b, c
```

```
<ctrl>b, n
```

```
<ctrl>b, n
```

# BSD/Solaris Config.

- Use ZFS
  - decrease block size to 8K
- increase shmmax/shmall on BSD
- may need to mess with ulimits
  - on very busy systems
  - Postgres will give you errors

# Windows/OSX

*optimization not possible*

# the xlog

- xlog == WAL
  - where transactions are recorded
- best on its own drive/volume
  - write-only
  - writes synchronously
  - response time paramount
- create volume, then link pg\_xlog dir

# xlog dir

```
<ctrl>b,n
```

```
cd 9.4/main/pg_xlog
```

```
ls -lh
```

# postgresql.conf

**parameters  
you care  
about:**

10 to 25

**parameters  
you don't care  
about:**

206 to 207

# postgresql.conf

```
cd  
/etc/postgresql/9.4/main  
$EDITOR postgresql.conf
```

- editors available:
  - joe, jmacs, vi, vim, nano



# postgresql.conf

```
psql  
show max_connections;  
show all;  
\x  
  
select * from  
pg_settings;
```



**connections  
&  
security**

# network

- local connections: unix sockets
  - faster than TCP/IP
- other servers: port 5432
  - make sure it's open on the firewall!
- on the cloud? use SSL
  - secure your connections
  - PITA to set up, though

# max\_connections

`"ERROR: connection limit  
exceeded for non-superusers"`

- postgresql.conf
- increase number of connections
- good up to about  $20 + 10 \times \text{cores}$
- keep needing to increase it?  
something is wrong

# security

`"FATAL: password authentication failed for user "wwwuser""`

- Postgres users & passwords
  - CREATE/ALTER USER
  - “group” ROLES
- Or: use LDAP, GSSAPI or PAM

# create user

```
psql
```

```
create user 'bench'  
password 'benchmark';
```

```
\du
```

```
\q
```

# host-based access

```
"FATAL: no pg_hba.conf entry for host  
"192.168.0.1", user "chaos", database  
"chaosLRdb", SSL off"
```

- pg\_hba.conf
- access control list:
  - database/user/host address
  - like iptables for Postgres
- change config and reload

# pg\_hba.conf

```
<ctrl>b,n
```

```
$EDITOR /etc/postgresql  
/9.4/main/pg_hba.conf
```

```
service postgresql  
reload
```



# pg\_hba.conf

```
<ctrl>b,n
```

```
psql
```

```
\q
```

```
psql -U bench
```

```
\q
```

# **.pgpass**

```
cd ~  
cp /setup/postgres/.pgpass .  
chmod 700 .pgpass  
less .pgpass  
psql -U bench
```

# three tips for security

1. don't expose the postgres server/port to the internet
2. don't allow users to connect as the superuser (postgres)
3. use the strongest authentication which is practical

# connection pooling

- pgbouncer
  - event-based pooler
  - separate package
  - on DB server, or
  - app server, or
  - 3<sup>rd</sup> “bouncer” server

# pgbench

- simple “benchmark” utility
  - based on “Wconsin” benchmark
  - ships in postgresql-contrib
  - useful for testing for really bad OS/hardware issues
  - also for demos

# setting up pgbench

```
createdb bench
```

```
pgbench -U bench -i -s 10
```

# pgbouncer

```
<ctrl>b,n
```

```
less /etc/pgbouncer/pgbouncer.ini
```

```
less /etc/pgbouncer/userlist.txt
```

```
service pgbouncer start
```

```
<ctrl>b,n
```

```
psql -U bench -p 6432
```

```
\q
```

# pgbouncer

```
cd /setup/pgbench  
less runbench_pool.sh  
./runbench_pool.sh  
<ctrl>b,n  
su - postgres  
psql
```



# pgbouncer

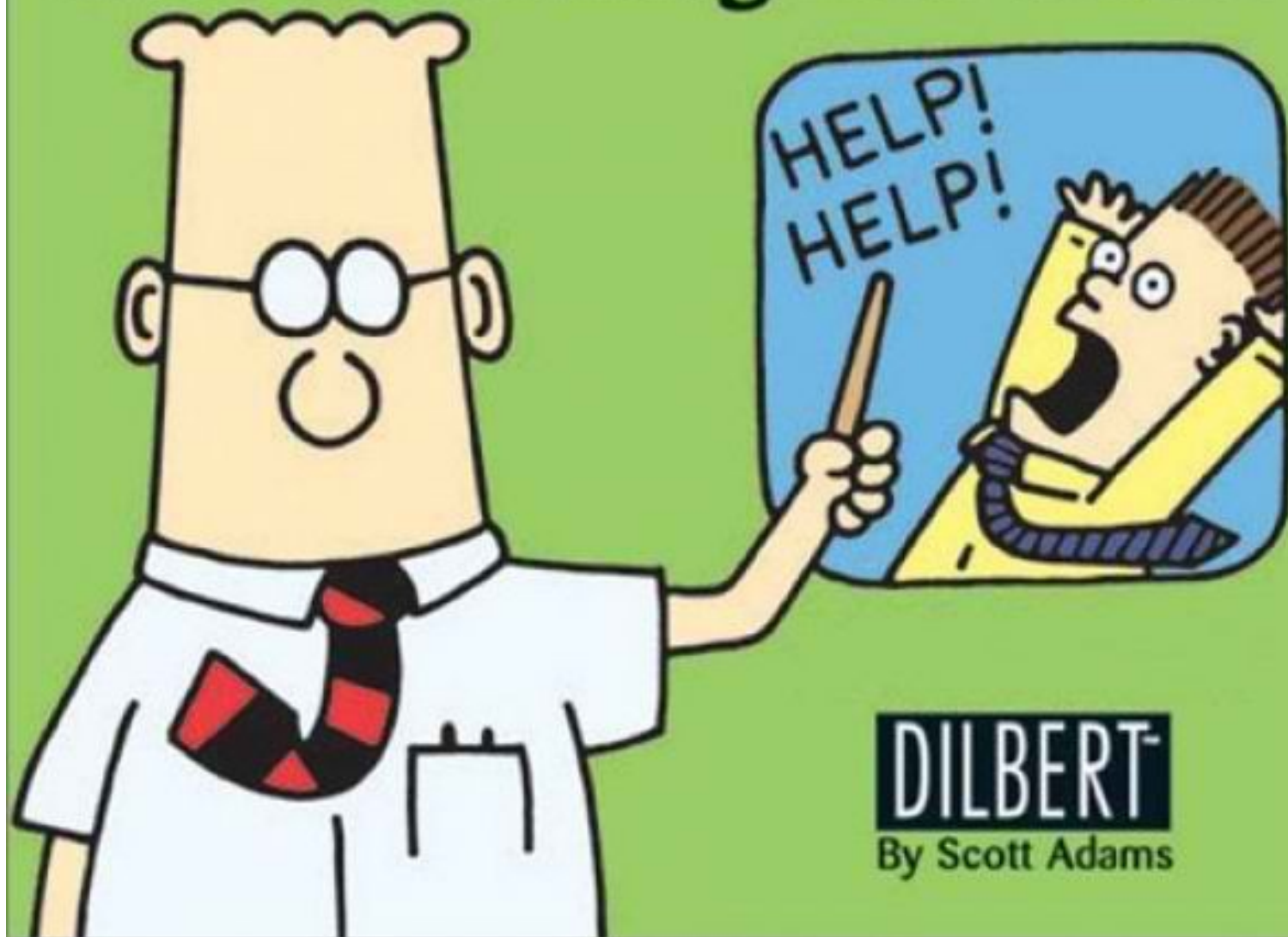
```
select count(*) from  
pg_stat_activity;  
\q  
<ctrl>b,n  
<ctrl>c
```



**backups**

```
2012-01-27 18:00:44 MSK FATAL:  
    invalid page header in block  
    311757 of relation  
    base/26976/27977  
2012-01-27 18:00:44 MSK CONTEXT:  
    xlog redo insert:  
    rel 1663/26976/27977;  
    tid 311757/44  
2012-01-27 18:00:44 MSK LOG:  
    startup process (PID 392)  
    exited with exit code 1  
2012-01-27 18:00:44 MSK LOG:  
    aborting startup due  
    to startup process failure
```

# Our Disaster Recovery Plan Goes Something Like This...



**DILBERT**  
By Scott Adams

# three methods

A) pg\_dump

B) PITR

C) filesystem snapshot

# pg\_dump

- “logical” backup
  - portable
  - compressed
  - works for upgrades
- good for small databases
- use -Fc
  - custom binary format

# pg\_restore

- used to reload pg\_dumps
  - parallel mode for fast loading
  - extract specific tables, schema
  - extract to an alternate database

# pgdump

```
cd ~
```

```
pg_dump -Fc -v
```

```
-f backup/libdata.dump
```

```
libdata
```

```
ls -lh backup/libdata.dump
```

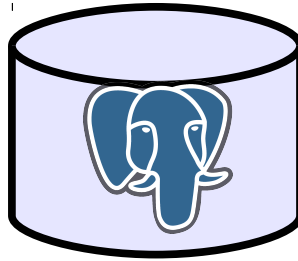
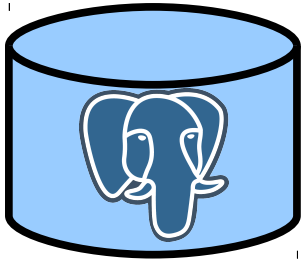


# pg\_restore

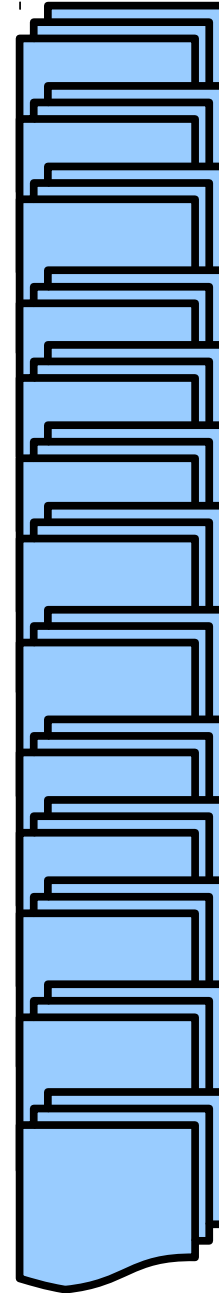
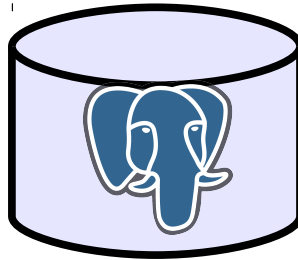
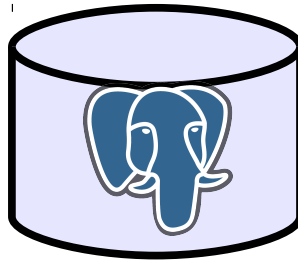
```
pg_restore -l backup/libdata.dump  
createdb libdata2  
pg_restore -v -d libdata2  
        backup/libdata.dump  
psql libdata2  
\dt  
\q
```

# PITR

- “Point-In-Time Recovery”
- “binary” and “continuous” backup
  - take snapshot of DB files
  - accumulate logfile copies
- good for large databases
- can combine with replication



DROP TABLE  
circulation;



# PITR - PITA

- can be difficult to set up & monitor
- use tools:
  - Barman
  - OmniPITR
  - WAL-E (for AWS)

# PITR

```
<ctrl>b,n
```

```
exit
```

```
$EDITOR /etc/postgresql/9.4/main  
/postgresql.conf
```

```
$EDITOR /etc/postgresql/9.4/main  
/pg_hba.conf
```

```
service postgresql restart
```

```
less /setup/postgres/archive_logs.sh
```

# PITR

```
<ctrl>b,n
```

```
cd ~
```

```
pg_basebackup -P -D 9.4/replica
```

```
cd wal_archive
```

```
ls -lh
```

```
...
```

# filesystem snapshot

- works with snapshotting filesystems
  - ZFS, BTRFS
  - LVM
  - Some SANs
- must be real snapshot
  - coherent
  - point-in-time

# have a DR plan

- ways you can lose data
  - recovery time
  - acceptable data loss
- how to recover from lost data
  - detailed steps
  - verification



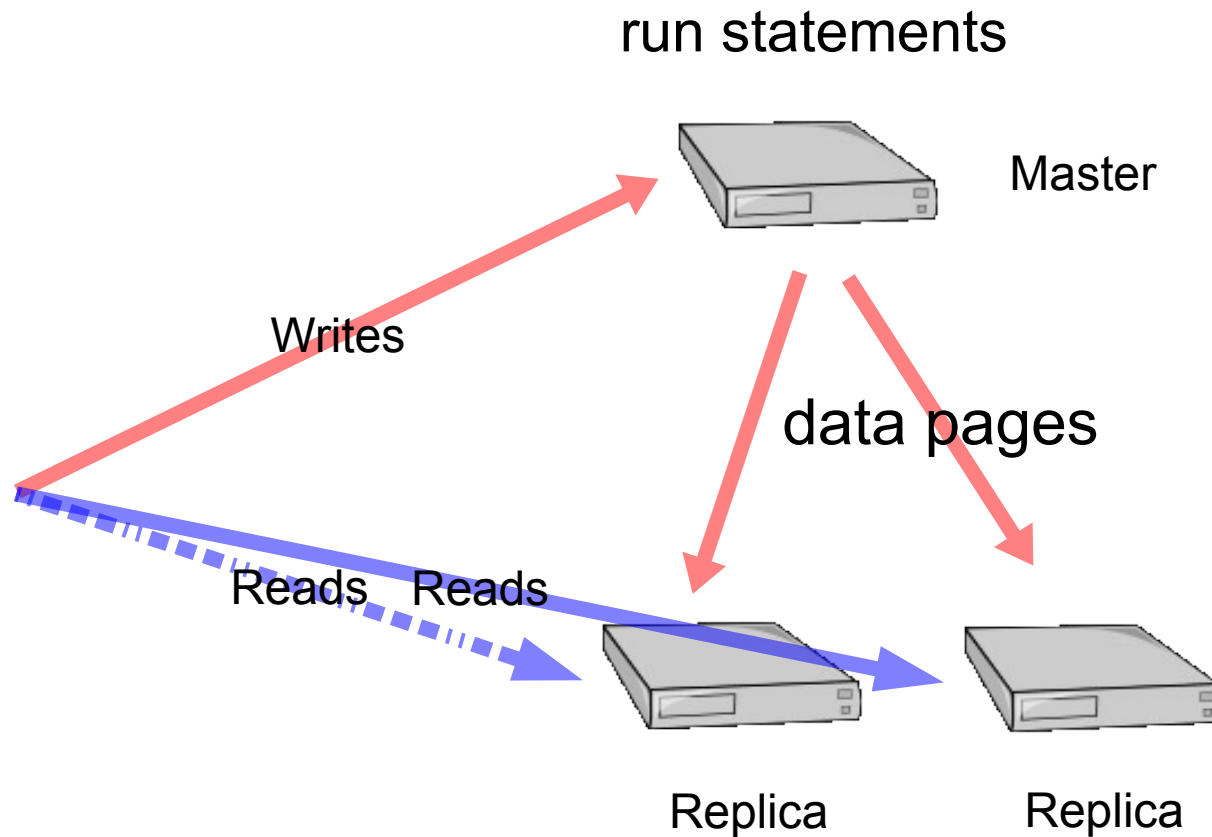


**replication**

# use replication for ...

- **availability:** have an “always on” failover server
- **load-balancing:** offload traffic
  - especially reporting workloads
- **security:** provide users read-only access

# binary replication



# also called ...

- **streaming replication**
  - refers to the ability to stream new data pages over a network connection
- **hot standby**
  - refers to the ability of standbys to run read-only queries while in standby mode

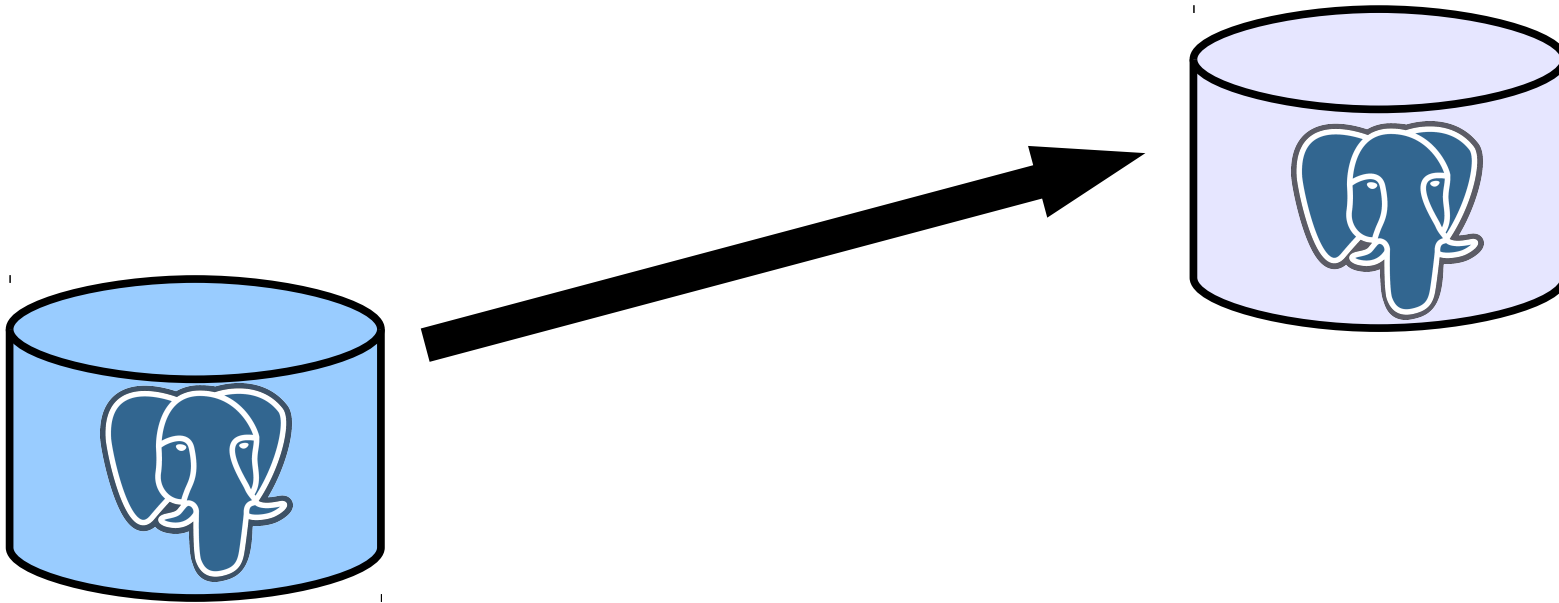
# advantages

- low administration
- low overhead on master
  - not much incremental cost
- non-invasive
  - no extra tables/triggers
  - no primary key requirements
  - no limitations on statements

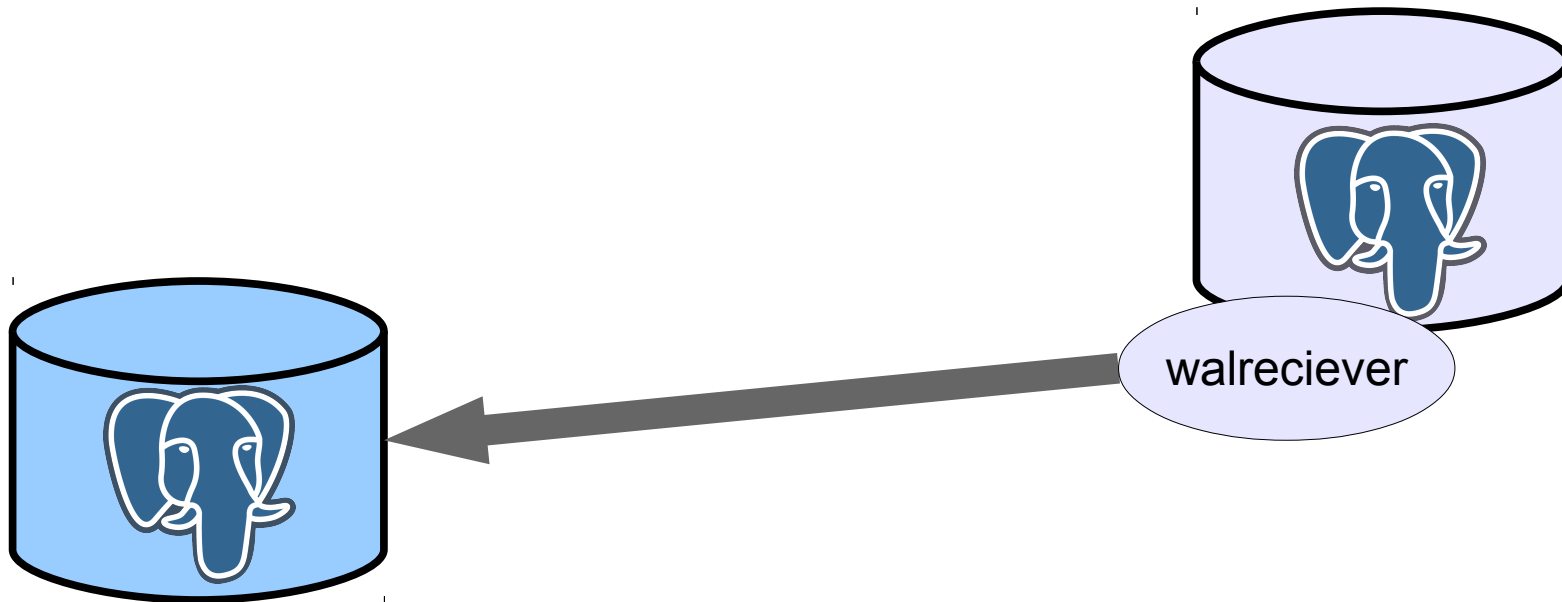
# disadvantages

- need to replicate the whole server
  - not individual databases or tables
- no writes of any kind on replicas
- some things not replicated
- query cancel (described later)

# how it works

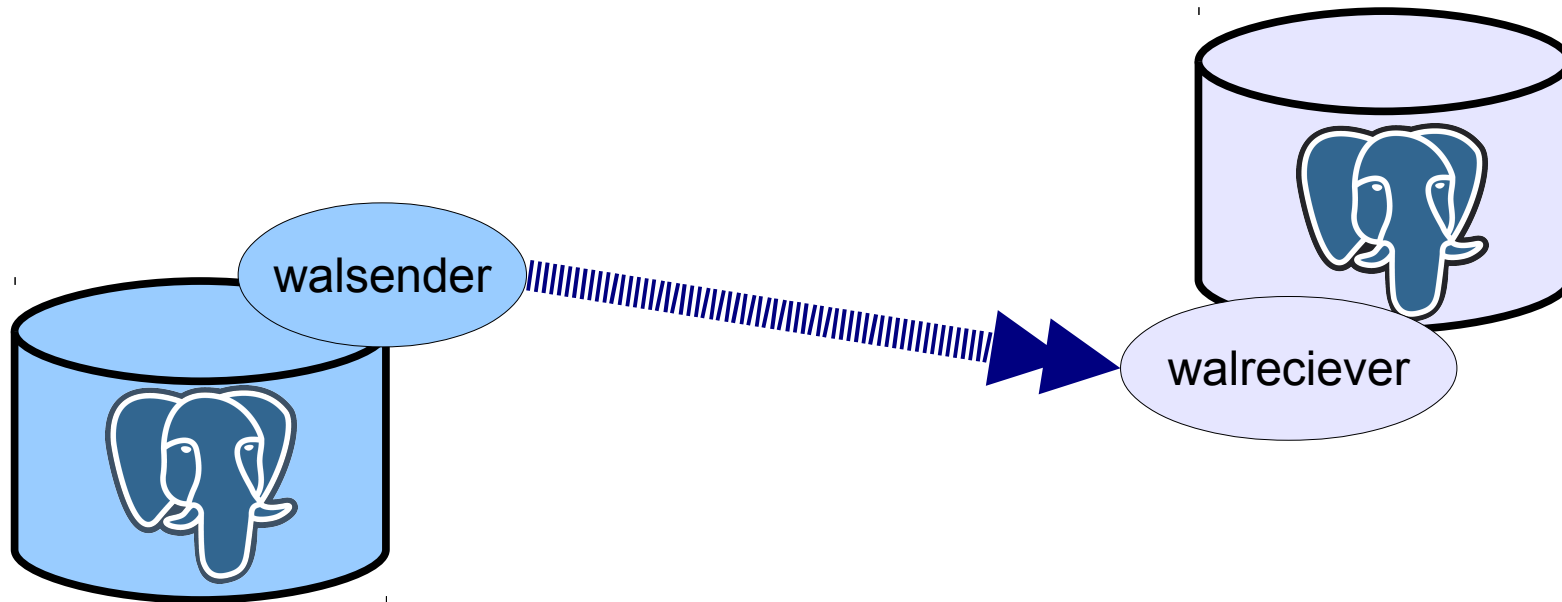


# how it works

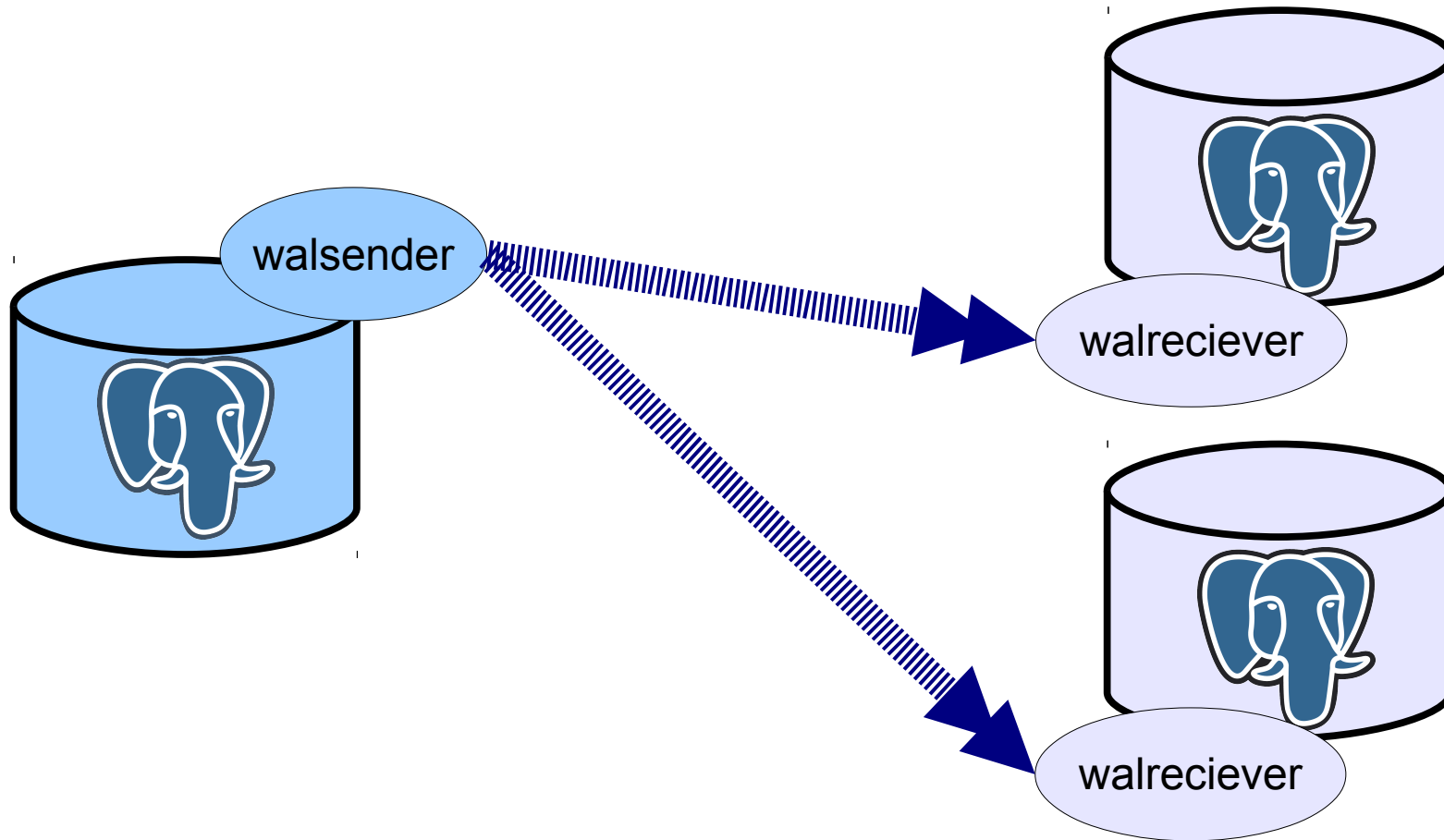




# how it works



# how it works



# “recovery”

- historical term
  - because replication grew out of PITR
- used to refer to the replica being “in recovery mode”, i.e no write queries
- all over parameter and file names
  - recovery.conf
  - recovery\_target
  - pg\_is\_in\_recovery()

# replication

```
<ctrl>b,n
```

```
cd ~/9.4/replica
```

```
cp -p -r
```

```
/setup/postgres/archive/* .
```

```
less recovery.conf
```

```
pg_ctl -D . start
```

# replication

```
psql -p 5433
```

```
select pg_is_in_recovery();
```

```
\q
```

```
psql -p 5432
```

```
select * from
```

```
    pg_stat_replication;
```

```
\q
```

# failover

```
pg_ctl -D . promote
```

```
psql -p 5433
```

```
select * from pg_is_in_recovery();
```

```
\q
```

```
pg_ctl -D . stop
```

# failover vs. load-balancing

load causes replicas to fall behind

your replica can work for:

- rapid failover
- offloading work

but not both!

# other replication

- synchronous replication
- Slony-I
- Londiste
- Bucardo





**monitoring**

# use your favorite tool

ganglia, collectd, Hyperic, OpenNMS, OpenView, whatever ....

- nagios check\_postgres.pl
  - broad list of checks
  - mine it for queries and techniques

# many useful checks

- disk space
- caching RAM
- response time
- connections
- idle transacts
- table growth
- waiting queries
- long queries
- database size
- table bloat
- system load
- replication lag
- XID wraparound
- execution time

# OS checks

- disk space (per volume!)
- system load
- memory usage
- IO activity
- network activity

# database checks

- connections: active, idle, idle xtns
- blocked queries (number, time)
- query times (pg\_stat\_statements)
- table size & growth
- table & index bloat
- XID wraparound
- replication lag

# activity log

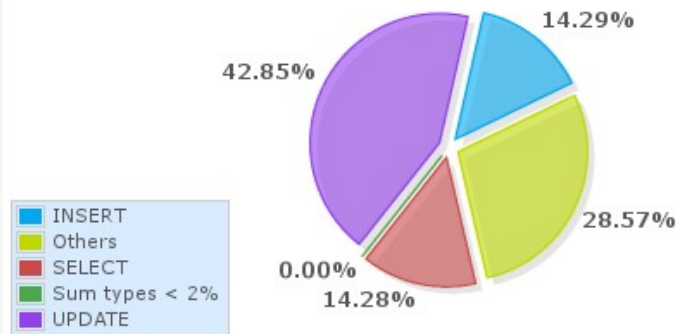
- connections & disconnections
- slow queries
- DB swap usage
- schema changes
- lock waits & deadlocks

# pgbadger

## Queries by type ^

| Type   | Count   | Percentage |
|--------|---------|------------|
| SELECT | 48,568  | 14.28%     |
| INSERT | 48,578  | 14.29%     |
| UPDATE | 145,701 | 42.85%     |
| DELETE | 0       | 0.00%      |
| OTHERS | 97,154  | 28.57%     |

Type of queries



To Image

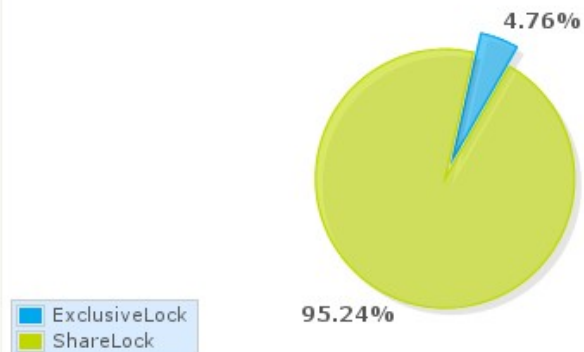
Download

Reset

## Locks by type ^

| Type          | Object      | Count | Total Duration | Av. duration (s) |
|---------------|-------------|-------|----------------|------------------|
| ExclusiveLock |             | 1     | 1.14s          | 1.14s            |
|               | tuple       | 1     | 1.14s          | 1.14s            |
| ShareLock     |             | 20    | 25.46s         | 1.27s            |
|               | transaction | 20    | 25.46s         | 1.27s            |
| Total         |             | 21    | 26.60s         | 1.27s            |

Type of locks



# DB activity

```
<ctrl>b,n
```

```
$EDITOR /etc/postgresql/9.4/main  
/postgresql.conf
```

```
service postgresql reload
```

```
<ctrl>b,n
```

```
cd /setup/pgbench
```

```
runbench_log.sh
```



# DB activity

```
<ctrl>b,n
```

```
su - postgres
```

```
psql
```

```
select * from pg_stat_activity;
```

```
\x
```

```
select * from pg_stat_activty;
```

# DB activity

```
\c bench  
  
select * from pg_stat_user_tables;  
  
select pg_size_pretty(  
    pg_total_relation_size(  
        'pgbench_history'));  
  
select * from pg_stat{TAB}
```

# DB logs

```
exit
```

```
cd /var/log/postgresql
```

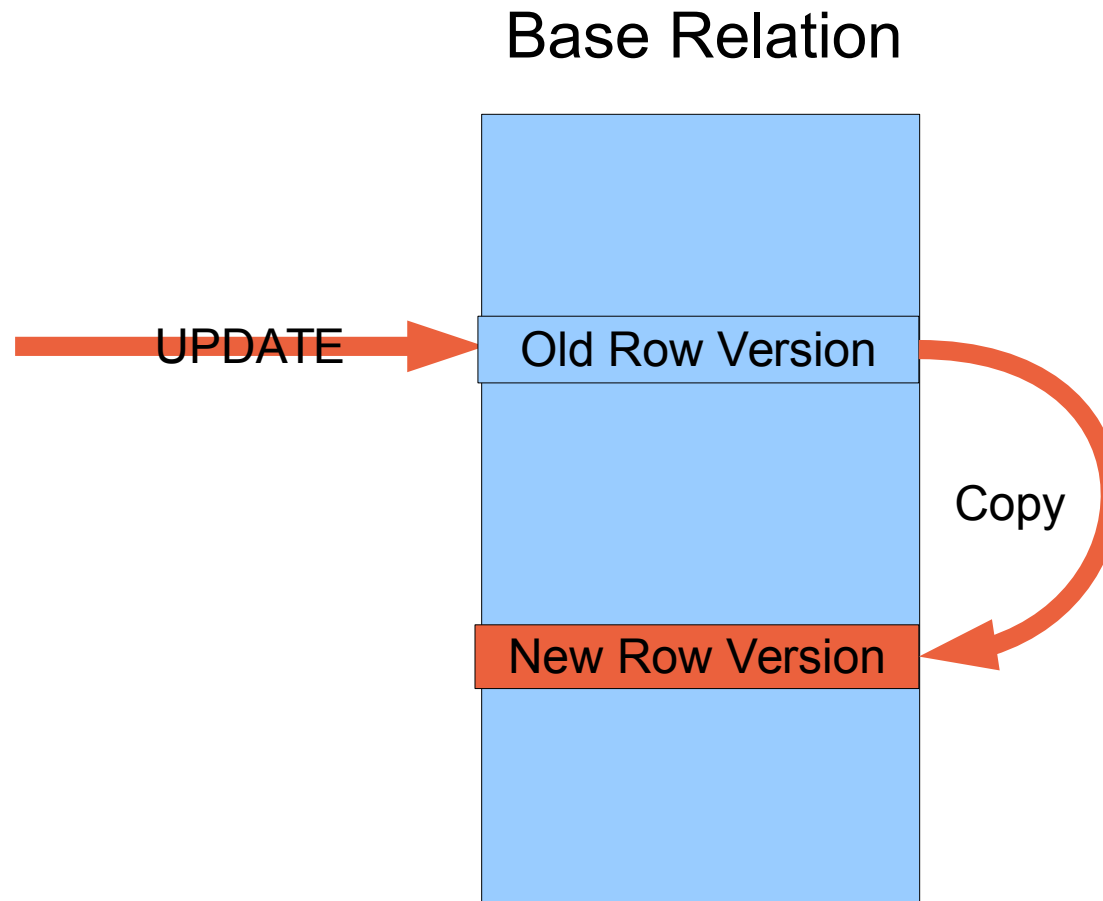
```
less activitylog-Mon.csv
```

```
pgbadger --format csv --out  
    /setup/postgres/badger.html  
    activitylog-Mon.csv
```

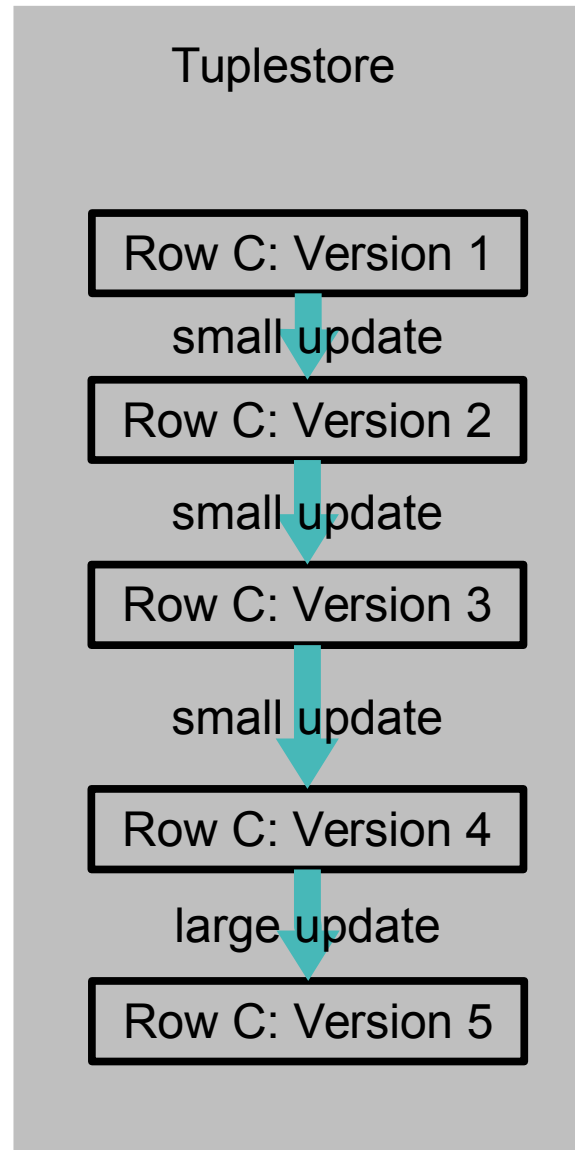


**VACUUM  
& ANALYZE**

# non-overwriting



# garbage collection



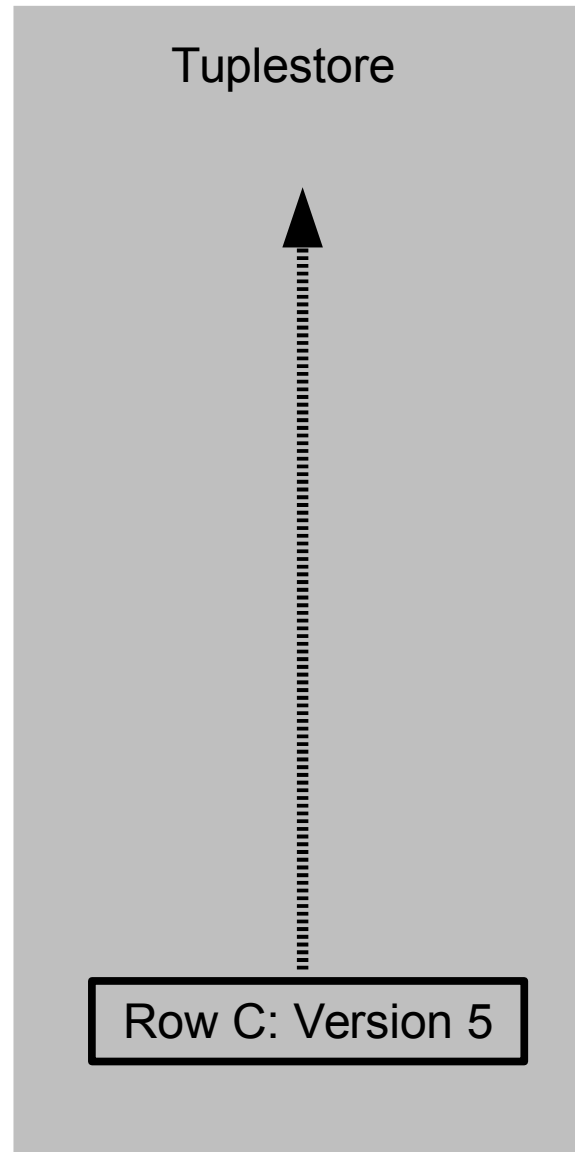
# garbage collection

Tuplestore

Row C: Version 5



# garbage collection





# garbage collection

Tuplestore

Row C: Version 5



# garbage collection

Tuplestore

Row C: Version 5



# Autovacuum



# falling behind



# bloat check

- pg\_stat\_user\_tables:  
dead\_rows/live\_rows
- nagios bloat query
  - [github.com/pgexperts/pgx\\_scripts/bloat](https://github.com/pgexperts/pgx_scripts/bloat)
- trend table/database size
- scans very slow to return the first row

# fixing bloat

- manual VACUUMs
  - even VACUUM FULL
- pg\_repack
- tune autovacuum
  - increase frequency for busy tables
  - increase workload size (vacuum\_cost\_limit)
  - more autovacuum workers

# vacuum

```
<ctrl>b,n
```

```
psql bench
```

```
\x
```

```
select * from pg_stat_user_tables;
```

```
select pg_total_relation_size(  
    'pgbench_tellers');
```

# **vacuum**

```
vacuum analyze pgbench_tellers;  
select pg_total_relation_size(  
    'pgbench_tellers');  
vacuum full pgbench_tellers;  
select pg_total_relation_size(  
    'pgbench_tellers');
```



# XID wraparound



# preempt wraparound

- track age(datfrozenxid) for each table
  - nagios has probe for this
- VACUUM FREEZE tables preemptively
  - <https://github.com/pgexperts/flexible-freeze>
- lower vacuum\_freeze\_min\_age
  - maybe to 250,000

# xid freezing

```
select relname,  
       age(relfrozenxid) as xid_age  
from pg_class JOIN  
pg_stat_user_tables USING (relname)  
order by xid_age desc;  
  
VACUUM FREEZE;  
  
select relname ...
```

# ANALYZE

- keeps DB statistics up to date
- non-intrusive
  - uses sampling
  - low IO
- should be run frequently (hourly?)
  - autovacuum takes care of this
- when not run, query plans get really bad

# ANALYZE

- manual ANALYZE when:
  - you create & populate a brand new table
  - you do a massive DELETE or TRUNCATE
  - you're seeing bad query plans due to bad stats
- ANALYZE individual tables

# stats

```
\a
```

```
select * from pg_stats where  
schemaname = 'public';
```



**managing queries**

# pg\_stat\_activity

```
-[ RECORD 2 ]-----+-----  
datid          | 16422  
datname        | libdata  
procpid        | 46295  
usesysid       | 10  
username       | dataentry  
application_name | psql  
client_addr    | 192.168.101.114  
client_port    | 5432  
backend_start  | 2012-08-26 15:09:05.233-07  
xact_start     | 2012-08-26 15:09:06.113-07  
query_start    | 2012-08-26 15:11:53.521-07  
waiting        | f  
current_query   | <IDLE> in transaction
```



# locks

- write queries can block on other write queries
  - as can table schema changes
  - queries can wait forever on locks
- look for old “idle in transaction”
  - that's a zombie database connection



**kill it kill it kill it**

# killing zombies

- `pg_cancel_backend(pid)`
  - kills running queries with `sigINT`
  - like `CTRL-C`
- `pg_terminate_backend(pid)`
  - kills bad connections, idle transactions
  - can cause DB to reload in some cases

# zombie killing

```
cd /setup/pgbench  
runbench_locks.sh  
<ctrl>b,n  
su - postgres  
psql bench  
select * from pg_stat_activity;
```

# zombie killing

```
select pg_cancel_backend(pid)
from pg_stat_activity
where state = 'idle in transaction'
and state_change <
( now() - interval '10 seconds');
```

```
select * from pg_stat_activity;
```

# EXPLAIN

```
Nested Loop (cost=792.00..828.08 rows=1422317 width=99)
  -> HashAggregate (cost=792.00..792.00 rows=1 width=4)
    -> Index Scan using
index_player_summaries_on_player_id on player_summaries
ps (cost=0.00..791.80 rows=403 width=4)
      Index Cond: (player_id = 21432312)
  -> Index Scan using index_player_summaries_on_match_id
on player_summaries (cost=0.00..33.98 rows=600 width=99)
      Index Cond: (match_id = ps.match_id)
```

# EXPLAIN ANALYZE

```
Nested Loop  (cost=792.00..828.08 rows=1422317  
width=99)  (actual time=9928.869..20753.723  
rows=13470 loops=1)
```

```
  -> HashAggregate  (cost=792.00..792.00 rows=1 width=4)  
  (actual time=9895.105..9897.096 rows=1347 loops=1)
```

```
    -> Index Scan using  
    index_player_summaries_on_player_id on player_summaries  
    ps  (cost=0.00..791.80 rows=403 width=4)  (actual  
time=27.413..9890.887 rows=1347 loops=1)
```

```
      Index Cond: (player_id = 21432312)
```

```
    -> Index Scan using index_player_summaries_on_match_id  
    on player_summaries  (cost=0.00..33.98 rows=600 width=99)  
    (actual time=7.375..8.037 rows=10 loops=1347)
```

```
      Index Cond: (match_id = ps.match_id)
```

```
Total runtime: 20764.371 ms"
```

# explain.depesz.com

options

HTML TEXT STATS

| exclusive | inclusive | rows x   | rows  | loops | node  |
|-----------|-----------|----------|-------|-------|---|
| 30.788    | 20753.723 | ↑ 105.6  | 13470 | 1     | → Nested Loop<br>(cost=792.00..828.08 rows=1422317 width=99)<br>(actual time=9928.869..20753.723 rows=13470 loops=1)  |
| 6.209     | 9897.096  | ↓ 1347.0 | 1347  | 1     | → HashAggregate (cost=792.00..792.00 rows=1 width=4)<br>(actual time=9895.105..9897.096 rows=1347 loops=1)  |
| 9890.887  | 9890.887  | ↓ 3.3    | 1347  | 1     | → Index Scan using<br>index_player_summaries_on_player_id on<br>player_summaries ps<br>(cost=0.00..791.80 rows=403 width=4)<br>(actual time=27.413..9890.887 rows=1347 loops=1)<br>Index Cond: (player_id = 21432312) |
| 10825.839 | 10825.839 | ↑ 60.0   | 10    | 1347  | → Index Scan using<br>index_player_summaries_on_match_id on<br>player_summaries<br>(cost=0.00..33.98 rows=600 width=99)<br>(actual time=7.375..8.037 rows=10 loops=1347)<br>Index Cond: (match_id = ps.match_id)      |



# explain.depesz.com

options

HTML TEXT STATS

| exclusive | inclusive | rows x   | rows  | loops | node  |
|-----------|-----------|----------|-------|-------|---|
| 30.788    | 20753.723 | ↑ 105.6  | 13470 | 1     | → Nested Loop<br>(cost=792.00..828.08 rows=1422317 width=99)<br>(actual time=9928.869..20753.723 rows=13470 loops=1)  |
| 6.209     | 9897.096  | ↓ 1347.0 | 1347  | 1     | → HashAggregate (cost=792.00..792.00 rows=1 width=4)<br>(actual time=9895.105..9897.096 rows=1347 loops=1)  |
| 9890.887  | 9890.887  | ↓ 3.3    | 1347  | 1     | → Index Scan using<br>index_player_summaries_on_player_id on<br>player_summaries ps<br>(cost=0.00..791.80 rows=403 width=4)<br>(actual time=27.413..9890.887 rows=1347 loops=1)<br>Index Cond: (player_id = 21432312) |
| 10825.839 | 10825.839 | ↑ 60.0   | 10    | 1347  | → Index Scan using<br>index_player_summaries_on_match_id on<br>player_summaries<br>(cost=0.00..33.98 rows=600 width=99)<br>(actual time=7.375..8.037 rows=10 loops=1347)<br>Index Cond: (match_id = ps.match_id)      |

# what to look for

- “seq scan” on large table
  - maybe index needed
- cartesian joins
- really bad row estimates
  - ANALYZE needed?

# explain analyze

```
explain select count(*) from loans  
where checkout_date between '2011-  
01-01' and '2011-03-31';
```

```
explain analyze ...
```

```
explain ( analyze on, buffers  
on ) ...
```

```
explain ( analyze on, format  
yaml ) ...
```

# explain analyze

```
\i /setup/postgres/  
    explain_quarterly_report.sql
```

# Learn More

- Main Docs
  - <http://www.postgresql.org/docs>
- Blogs
  - <http://planet.postgresql.org>
- User Groups
  - <http://www.postgresql.org/community/user-groups/>

# Learn More

## User Groups:

- SFPUG
- PDXPUG
- NYCPUG
- many others!

## Conferences:

- FOSDEM
- pgConf NYC
- pgCon Ottawa
- pgConfSV

# questions?

- [www.pgexperts.com/tutorials.html](http://www.pgexperts.com/tutorials.html)
- Josh Berkus: [josh@pgexperts.com](mailto:josh@pgexperts.com)
  - PGX: [www.pgexperts.com](http://www.pgexperts.com)
  - Blog: [www.databasesoup.com](http://www.databasesoup.com)



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