PostgreSQL Logging

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EnterpriseDB

PgOpen 18 Sep 2012

...not just for lumberjacks

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Why you want logs

```
:::-->pg_ctl -D /usr/local/pgsql/data/ restart
waiting for server to shut down.... done
server stopped
server starting
```

Why you want logs

```
payroll_dev=# UPDATE employees
SET salary = (salary/5)
WHERE emp_name = 'Magnus Hagander';
```

Why you want logs

```
payroll_prod=# DROP TABLE employees;
DROP TABLE
payroll_prod=# ROLLBACK;
NOTICE:  there is no transaction in progress
ROLLBACK
```

Why you want logs

- Historical record
  - starts, stops, reloads of config file
  - who's connected
  - data or schema changes
- Troubleshooting aid
- Legal requirement

The Basics

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The Basics:
How to get logs Easy!

```
#logging_collector = off
logging_collector = on
```

- make this change to postgresql.conf
- ...and restart

The Basics:
A few more things you need to know...

- Find your logs at:
  - $PGDATA/pg_log/postgresql-[timestamp].log
  - aka: log_directory and log_filename

The Basics:
A few more things you need to know...

```
-rw------- 1 pg pg  3559313 2012-09-10 23:59 postgres-2012-09-08_000000.log
-rw------- 1 pg pg  1515440 2012-09-11 19:44 postgres-2012-09-11_000000.log
-rw------- 1 pg pg  4613971 2012-09-12 18:42 postgres-2012-09-12_000000.log
-rw------- 1 pg pg  2250845 2012-09-13 17:35 postgres-2012-09-13_000000.log
-rw------- 1 pg pg 10485934 2012-09-14 08:28 postgres-2012-09-14_000000.log
-rw------- 1 pg pg 10485769 2012-09-14 08:28 postgres-2012-09-14_082822.log
-rw------- 1 pg pg 10485833 2012-09-14 10:03 postgres-2012-09-14_082835.log
-rw------- 1 pg pg 10485794 2012-09-14 10:03 postgres-2012-09-14_100319.log
-rw------- 1 pg pg 10485773 2012-09-14 10:03 postgres-2012-09-14_100335.log
-rw------- 1 pg pg 10485820 2012-09-14 10:04 postgres-2012-09-14_100351.log
```

- #log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'
- #log_rotation_age = 1d
- #log_rotation_size = 10MB
- don't forget to clean up!

Voila.

```
LOG:  received smart shutdown request
LOG:  autovacuum launcher shutting down
LOG:  shutting down
LOG:  database system is shut down
LOG:  database system was shut down at [whenever]
LOG:  database system is ready to accept connections
LOG:  autovacuum launcher started
```

The Basics:
Recap

```
#log_destination = 'stderr'
logging_collector = on
#log_directory = 'pg_log'
#log_filename = 'enterprisedb-%Y-%m-%d_%H%M%S.log'
#log_rotation_age = 1d
#log_rotation_size = 10MB
#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

...now let's customize it a bit

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Logging-related GUCs in postgresql.conf

- Three sections:
  - Where to Log
  - When to Log
  - What to Log
  - ...and some random locations.
- Defaults are pretty conservative
- Most parameters require pg_ctl reload; others require restart (noted in postgresql.conf)

Customize:
What to Log

- who connected/disconnected
  - log_connections/log_disconnections
- what's changed
  - log_statement
- apply message prefix*
  - log_line_prefix

Customize:
who connected

```
#log_connections = off
#log_disconnections = off

log_connections = on
log_disconnections = on
```

Customize:
who connected

```
#log_connections = off
#log_disconnections = off

log_connections = on
log_disconnections = on
```

```
LOG:  connection authorized: user=gabrielle database=payroll_dev
LOG:  connection authorized: user=gabrielle database=payroll_prod
LOG:  disconnection: session time: 0:00:06.530 \
        user=gabrielle database=payroll_dev host=[local]
LOG:  disconnection: session time: 0:00:34.283 \
        user=gabrielle database=payroll_prod host=[local]
```

Customize:
what's changed

```
#log_statement = 'none'                    #none, ddl, mod, all
log_statement = 'mod'
```

Customize:
what's changed

```
#log_statement = 'none'                  #none, ddl, mod, all
log_statement = 'mod'
```

```
LOG:  statement: UPDATE employees
        SET salary = (salary/5)
        WHERE emp_name = 'Magnus Hagander';
LOG:  statement: DROP TABLE employees;
```

Customize:
add a message prefix

```
#log_line_prefix = ''    # special values:
                         #   %a = application name
                         #   %u = user name
                         #   %d = database name
                         #   %r = remote host and port
                         #   %h = remote host
                         #   %p = process ID
                         #   %m = timestamp with milliseconds
                         #   %e = SQL state
                         ...
                         #   %% = '%'


log_line_prefix = '%t <%d %u %r> %%'
```

Customize:
add a message prefix

```
log_line_prefix = '%t <%d %u %r> %%'

2011-03-12 21:23:22 PDT <payroll_dev gabrielle 10.88.8.7(62387)> %LOG:
    statement: UPDATE employees
    SET salary = (salary/5)
    WHERE emp_name = 'Magnus Hagander';
2011-03-12 21:23:47 PDT <payroll_prod gabrielle 10.88.8.7(62387)> %LOG:
    statement: DROP TABLE employees;
```

Customize:
resolve the hostname

```
log_line_prefix = '%t <%d %u %r> %%'

2011-03-12 21:23:22 PDT <payroll_dev gabrielle 10.88.8.7(62387)> %LOG:
    blahblahblahmessage
```

```
log_line_prefix = '%t <%d %u %r> %%'
#log_hostname = off
log_hostname = on

2011-03-12 21:23:22 PDT <payroll_dev gabrielle fabio(62387)> %LOG:
    blahblahblahmessage
```

Customize:
What to log recap

```
# - What to Log -
log_connections = on
log_disconnections = on
log_statement = 'mod'
log_line_prefix = '%t <%d %u %r> %%'
```

Customize:
When to Log

- message levels
  - log_min_messages
  - client_min_messages
  - log_min_error_statement
- long queries
  - log_min_duration_statement

Customize:
Message Levels

Let's talk about the levels first.

DEBUG, INFO, NOTICE, WARNING, ERROR,
LOG, FATAL, PANIC.
(or something like that.)

Customize:
log_ and client_min_messages, log_min_error_statement

```
#log_min_messages = warning      # what gets sent to your log
#client_min_messages = notice    # what gets sent to your client
#log_min_error_statement = error # SQL message level
```

the defaults are probably fine.

Customize:
Long Queries

```
#log_min_duration_statement = -1
log_min_duration_statement = 2000 # 2 seconds
log_min_duration_statement = 2s   # also 2 seconds

Looks like:
LOG:  duration: 2360.958 ms  statement:
  SELECT blahblahblah FROM woof_woof_moo_moo;
```

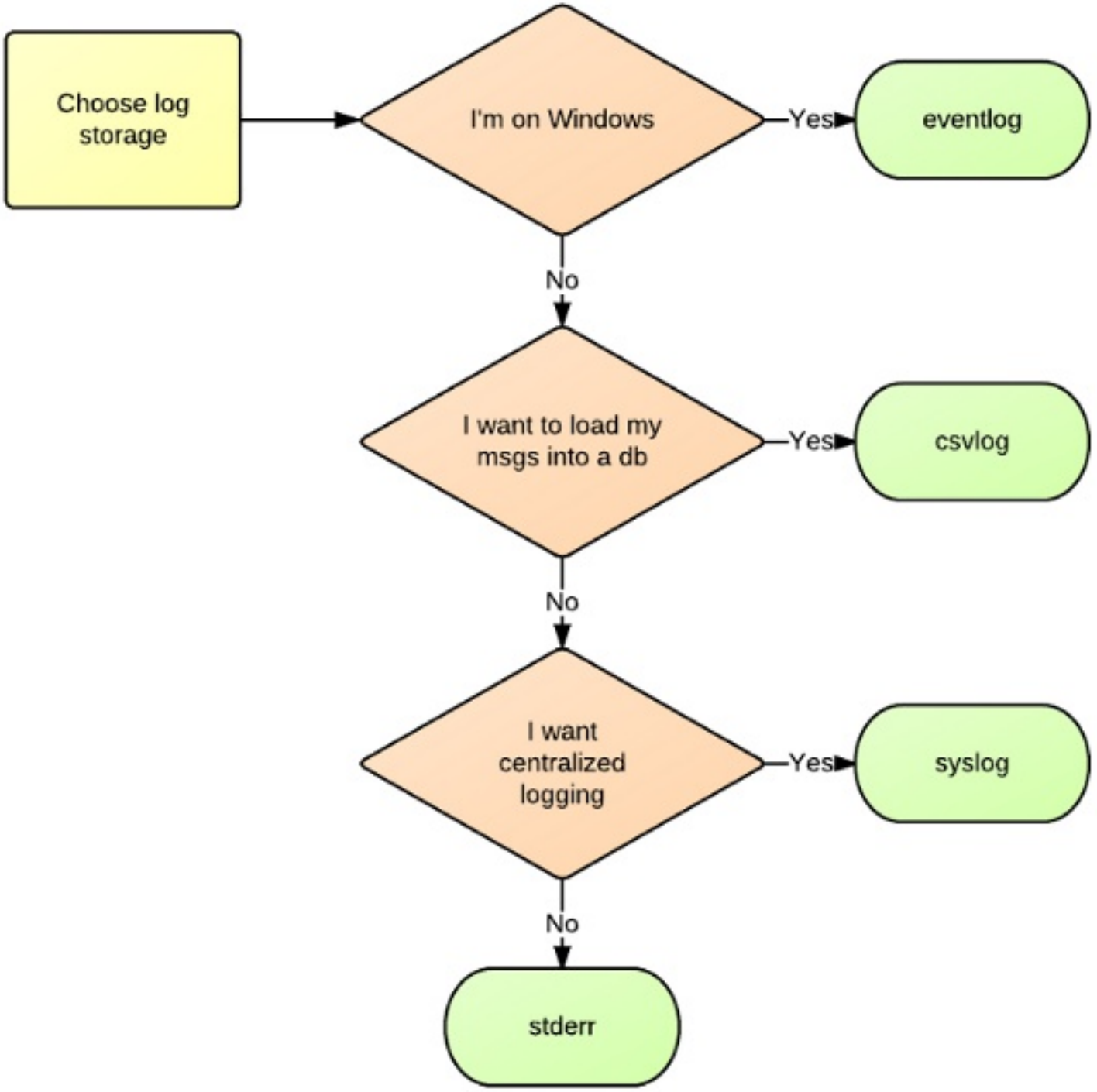
log_statement + log_min_duration_statement

```
log_statement = 'mod'
log_min_duration_statement = 2s
log_line_prefix = '<%d %u %r %p> %%'

Looks like:
<testy toadie [local] 25783> % LOG:  duration: 2562.006 ms
<testy toadie [local] 25783> % LOG:  statement: INSERT INTO table VALUES...
```

Customize:
Where to log

- You have four choices:
  - eventlog
  - csvlog
  - syslog
  - stderr



Made with LucidChart. Grossly oversimplified. Not for production use.

Customize:
eventlog (Windows)

- get service start/stop messages by default
- edit postgresql.conf
- restart via Services menu OR
  - reload via PgAdmin
- use Event Viewer to view
  - set up a custom filter to reduce annoyance

More help? see me afterwards or at the code sprint.

Customize:
stderr (review)

```
#log_destination = 'stderr'

#logging_collector = off          #requires restart
logging_collector = on

#log_directory = 'pg_log'
#log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'

#log_rotation_age = 1d
#log_rotation_size = 10MB
log_rotation_size = 0

#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

Customize:
stderr

- make sure the pg user has perms on the log directory, otherwise:

```
FATAL:  42501: could not create log file
"/home/gabrielle/fooled-ya.log": Permission denied
```

- ...and the database won't start.

Customize: stderr

- Pros:
  - easy!
  - Pg handles the log rotation for you
- Cons:
  - you need to ship logs yourself to a central server
  - you need to clean up old logs yourself

cleanup...

```
#!/usr/bin/bash

LOG_DIR=/usr/local/pgsql/logs
FIND=/usr/bin/find
AGE=6 # "today" counts as 0;
      # this gives me 8 days' worth of logs

${FIND} ${LOG_DIR}/ \
-name "postgresql.log.*" \
-mtime +6 \
-exec rm -f {} \;
```

Customize:
csvlog

```
#log_destination = 'stderr'
log_destination = 'csvlog'

#logging_collector = off          #requires restart
logging_collector = on

#log_directory = 'pg_log'
#log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'

#log_rotation_age = 1d
#log_rotation_size = 10MB
log_rotation_size = 0

#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

Customize:
csvlog

```
2012-08-31 18:59:24.049 PDT,,,3846,,50416bf1.f06,1,,2012-08-31 18:59:13 PDT,8/14
7,0,ERROR,57014,"canceling autovacuum task",,,,,"automatic analyze of table ""be
nchmarksql.public.order_line""",,,,""
2012-08-31 18:59:24.050 PDT,"postgres","benchmarksql",3878,"127.0.0.1:48340",504
16bfa.f26,21,"ALTER TABLE",2012-08-31 18:59:22 PDT,11/1078,3405615,NOTICE,00000,
"ALTER TABLE / ADD PRIMARY KEY will create implicit index ""pk_order_line"" for
table ""order_line""",,,,,,,,,""
2012-08-31 18:59:24.056 PDT,"agent1","pem",2264,"127.0.0.1:48089",50416a17.8d8,8
19,"idle",2012-08-31 18:51:19 PDT,3/4796,0,LOG,00000,"statement: SELECT ""index_
name"", ""table_name"", ""ind_keys"" FROM pemdata.oc_index WHERE ""server_id"" =
 '3' AND ""database_name"" = 'edb' AND ""schema_name"" = 'enterprisedb'",,,,,,,,
,"Postgres Enterprise Manager - Agent Control"
2012-08-31 18:59:24.056 PDT,"agent1","pem",2264,"127.0.0.1:48089",50416a17.8d8,8
20,"UPDATE",2012-08-31 18:51:19 PDT,3/4797,0,LOG,00000,"execute <unnamed>: UPDAT
E pem.probe_schedule SET current_backend_pid = NULL, last_execution_time = now()
 WHERE probe_id = $1 AND parameter_value_list = $2 AND current_backend_pid = pg_
backend_pid()","parameters: $1 = '5', $2 = '{3,edb,enterprisedb}'",,,,,,,,"Postg
res Enterprise Manager - Agent Control"
```

- log_filename = 'postgresql-[timestamp].log' but file is named postgresql-[timestamp].csv

Customize: csvlog

- Pros:
  - Pg handles the log rotation
  - you get a lot of cool stuff without extra effort
  - loading logs into a database is a snap!
- Cons:
  - you need to ship logs yourself to a central server
  - you need to clean up old logs yourself
  - logs are no longer human-readable
  - you may not agree with the available fields

Customize:
syslog

```
#log_destination = 'stderr'
log_destination = 'syslog'

#syslog_facility = 'LOCAL0'
syslog_facility = 'LOCAL5'

#log_line_prefix = ''
log_line_prefix = '%t <%d %u %r> %% '
```

Customize: syslog

- Pros:
  - centralized logging is easy
  - leverage existing systems
  - can do some fun stuff with syslog-ng
- Cons
  - requires access to syslog.conf
  - you need to provide log rotation, eg logadm.conf
    - which, conveniently, ages out old files, too.

Customize:
syslog caveats

- performance issues?
- I put a timestamp on my messages (docs recommend against that, so use at your own risk)
  - tz differences
  - ”network latency”
  - control freak

Recap

```
# - What to Log -
log_connections = on
log_disconnections = on
log_statement = 'mod'
log_line_prefix = '%t <%d %u %r> %%'


# - When to Log -
#client_min_messages = notice
#log_min_messages = warning
#log_min_error_statement = error
log_min_duration_statement = 5s


# - Where to Log -
# ... you decide.
```

Customize:
other stuff

- log_checkpoints
- log_autovacuum_min_duration
- log_error_verbosity

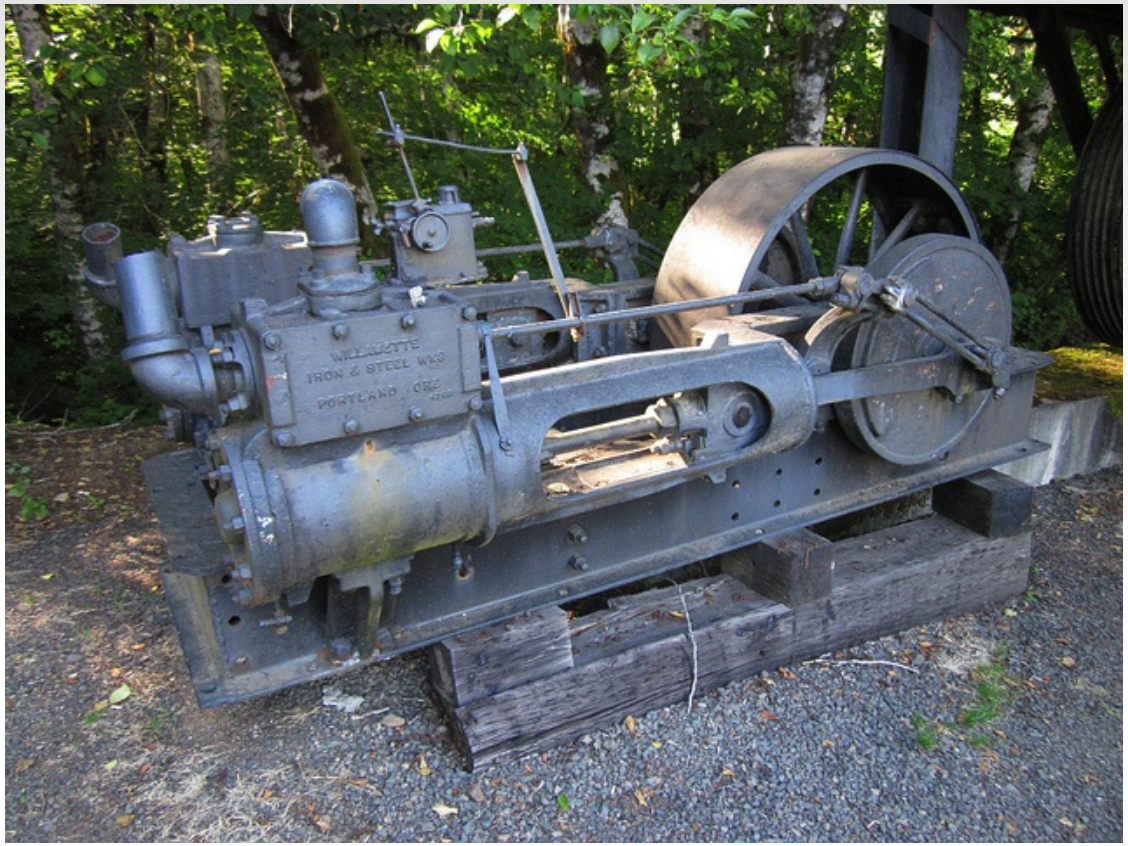
Override a configured value from psql

```
SET log_min_duration_statement = '2min';
```

Check settings from psql

```
SELECT name, setting, short_desc
 FROM pg_settings
 WHERE category LIKE 'Reporting and Logging%'
 ORDER BY 1;
```

Tools



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OK, I have logs. Now what.

- use your eyeballs!
- ...and Unix utils
  - tail, grep, sed, cut, awk, split -l
- throw it into a db
  - csvlog makes this easy
- automated reporting
  - roll your own
  - generic: splunk, logstash, etc
  - pg-specific: pgfouine, pgbadger

Tools:
csvlog -> database

- create a table (see the docs)
  - ”application field” added in 9.0
- `COPY 'my.log' TO log_table WITH CSV;`
- profit!
- pros:
  - disgustingly simple – **best for automated parsing**
  - you get a lot of cool stuff (pid, timestamp, SQL state code) automatically
- cons:
  - raw logs are not human-readable
  - don't get to choose your fields

FNNLC*

```
loggy=# SELECT date_trunc('hour', log_time) AS hour, error_severity, count(*)
FROM postgres_log
GROUP BY hour, error_severity
ORDER BY hour, error_severity;
          hour           | error_severity | count
-------------------------+----------------+-------
 2011-03-15 09:00:00-05 | LOG            |     4
 2011-03-15 10:00:00-05 | LOG            |     1
 2011-03-15 11:00:00-05 | LOG            |     1
 2011-03-15 12:00:00-05 | LOG            |     1
 2011-03-15 13:00:00-05 | LOG            |     1
 2011-03-15 14:00:00-05 | LOG            |     1
 2011-03-15 15:00:00-05 | ERROR          |     1
 2011-03-15 15:00:00-05 | LOG            |    25
 2011-03-15 16:00:00-05 | ERROR          |     6
 2011-03-15 16:00:00-05 | LOG            |  2144
 2011-03-15 16:00:00-05 | WARNING        |   147
 2011-03-15 17:00:00-05 | LOG            |     2
```

*Friday Night No Life Club

(generic) Tools:
splunk & logstash

- www.splunk.com
- logstash.net
- Splunk costs $$$$, logstash is open-source
- Both are easy to install
- Both require some tweaking to handle Pg log

Tools:
pgfouine

- pg log parser
- pgfouine.projects.postgresql.org
- pHp
- 8.4
- slow on larger logs

Tools:
pgbadger

- pg log parser
- https://github.com/dalibo/pgbadger
- Perl
- use this one :)

Tools:
pgfouine/pgbadger

```
./pgfouine.php \
-file postgresql.log \
-logtype stderr \
-report testy.html=overall,bytype,
     ...n-mostfrequent,n-slowestaverage,
     ...n-mostfrequenterrors \
-format html \
-top 10
```

```
./pgbadger postgresql.log
```

Tools:
pgfouine/pgbadger

- pros:
  - decent docs
  - cron-able
  - pretty, portable reports
- cons:
  - fouine is slow for large logs (badger is faster)
  - requires specific log_line_prefix:
    - log_line_prefix = '%t [%p]'
  - can't handle multi-line messages from stderr logtype

Tools:
fouine/badger caveats

- re-format your syntax (eg, select -> SELECT)
- don't recognize some lines:

```
Unrecognized LOG or DEBUG line: LOG:  aborting any active transactions - log line 56365
Unrecognized LOG or DEBUG line: LOG:  autovacuum launcher shutting down - log line 56367
Unrecognized LOG or DEBUG line: LOG:  shutting down - log line 56368
Unrecognized LOG or DEBUG line: LOG:  database system is shut down - log line 56369
Unrecognized LOG or DEBUG line: LOG:  database system was shut down at [...]
Unrecognized LOG or DEBUG line: LOG:  database system is ready to accept [...]
Unrecognized LOG or DEBUG line: LOG:  autovacuum launcher started - log line 56372
```

Further tweaking

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log_line_prefix:
SQL State error code (%e)

- 9.0+ (Guillaume Smet)
- 5-digit code that you can look up
  - and possibly find out a bit more about your error
- For example:

```
<22P02>ERROR:  invalid input syntax for integer: ...

<22003>ERROR:  value "4294967295" is out of range ...
```

  - 22P02 = ”invalid text representation”
  - 22003 = ”numeric value out of range”

per-user stats

```
ALTER USER gabrielle SET log_statement to 'all';
```

auto_explain

- contrib module - Takahiro Itagaki
- introduced in 8.4
- automatically runs EXPLAIN on every query that takes longer than a (super)user-specified value
- to install:
  - `cd /pg/src/contrib`
  - `make && make install`

auto_explain
postgresql.conf

```
shared_preload_libraries = 'auto_explain' #requires a restart
custom_variable_classes = 'auto_explain'
auto_explain.log_min_duration = '500'     #requires reload
```

auto_explain
psql

```
postgres=# LOAD 'auto_explain';
LOAD
postgres=# set auto_explain.log_min_duration = 500;
postgres=# \i 'queries_that_drive_me_bonkers.sql'
```

auto_explain

```
2010-10-11 10:24:15 PDT [11146]: [1552-1] user=markwkm,db=dbt5 LOG:  duration: 0.048 ms
plan:
        Query Text: UPDATE customer_account
        SET ca_bal = ca_bal + -11675.200000
        WHERE ca_id = 43000039241
        Update  (cost=0.00..8.28 rows=1 width=71)
          ->  Index Scan using pk_customer_account on customer_account  (cost=0.00..8.28
rows=1 width=71)
                Index Cond: ((ca_id)::bigint = 43000039241::bigint)
2010-10-11 10:24:15 PDT [11472]: [705-1] user=markwkm,db=dbt5 LOG:  duration: 12.903 ms
plan:
        Query Text: SELECT * FROM SecurityDetailFrame1(false,8,'2002-2-12','RDEN')
        Function Scan on securitydetailframe1  (cost=0.00..10.00 rows=1000 width=1080)
```

One last thing:

```
testy=# CREATE USER nimrod WITH PASSWORD 'hellothere';
LOG:  statement: CREATE USER nimrod WITH PASSWORD 'hellothere';

testy=# ALTER USER nimrod WITH PASSWORD 'whoopsie-daisy!';
LOG:  statement: ALTER USER nimrod WITH PASSWORD 'whoopsie-daisy!';
```

Instead:

```
testy=# \password nimrod
Enter new password:
Enter it again:
testy=#

LOG:  statement: ALTER USER nimrod PASSWORD 'md5f7blahblahblah'
```

Safety first (sort of)!

- Manage postgresql.conf in $vcs
  - git, svn, whatever
- Put your logs on their own partition
- Don't dink around with your settings and leave for the weekend.
- Monitor your monitoring (it's meta!)
  - especially file sizes/disk space

That's it!

photo by kcxd (flickr). Creative Commons license.

More...

”Query Logging and Workload Analysis”

Greg Smith

19 Sep 1:30pm

Thank you!

- console font: monofur by tobias b koehler
  http://www.dafont.com/monofur.font
- PDXPUG
- Josh Heumann
- feedback welcome!
  - Code sprint on Thursday
  - gorthx@gmail.com, @gorthx

PostgreSQL Logging

Gabrielle Roth
EnterpriseDB

PgOpen 18 Sep 2012

...not just for lumberjacks

photo by U.S. Fish and Wildlife Service - Midwest Region. Creative Commons license.

Why you want logs

```
:::-->pg_ctl -D /usr/local/pgsql/data/ restart
waiting for server to shut down.... done
server stopped
server starting
```

- So you have historical records of database events

Why you want logs

```
payroll_dev=# UPDATE employees
SET salary = (salary/5)
WHERE emp_name = 'Magnus Hagander';
```

Maybe your coworkers like to play jokes on each other.

Why you want logs

```
payroll_prod=# DROP TABLE employees;
DROP TABLE
payroll_prod=# ROLLBACK;
NOTICE:  there is no transaction in progress
ROLLBACK
```

Or maybe they're just clumsy.

Why you want logs

- Historical record
  - starts, stops, reloads of config file
  - who's connected
  - data or schema changes
- Troubleshooting aid
- Legal requirement

Also useful for diagnosing problems with front-end apps; looking for things like slow or failing queries.

You may have a legal requirement to track certain activities, and maybe to keep logs for a certain amount of time – or to NOT keep logs.

I really recommend that you have rudimentary logging set up, even if nobody else at your organization thinks this is important.

Key: You want to be able to find out **what happened**.

The Basics

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- comes with postgres, but not enabled by default
- all you have to do is turn it on!

The Basics:
How to get logs Easy!

```
#logging_collector = off
logging_collector = on
```

- make this change to postgresql.conf
- ...and restart

- Go find this parameter in postgresql.conf, uncomment it & change it to on, and restart the database.
- Then go see what you have in your logs.
- In this talk, the commented lines are the default values from postgresql.conf. New values are uncommented and altered.

- It really is just this simple!

- There are a couple more things you need to know though.

The Basics:
A few more things you need to know...

- Find your logs at:
  - $PGDATA/pg_log/postgresql-[timestamp].log
  - aka: log_directory and log_filename

The Basics:
A few more things you need to know...

```
-rw------- 1 pg pg  3559313 2012-09-10 23:59 postgres-2012-09-08_000000.log
-rw------- 1 pg pg  1515440 2012-09-11 19:44 postgres-2012-09-11_000000.log
-rw------- 1 pg pg  4613971 2012-09-12 18:42 postgres-2012-09-12_000000.log
-rw------- 1 pg pg  2250845 2012-09-13 17:35 postgres-2012-09-13_000000.log
-rw------- 1 pg pg 10485934 2012-09-14 08:28 postgres-2012-09-14_000000.log
-rw------- 1 pg pg 10485769 2012-09-14 08:28 postgres-2012-09-14_082822.log
-rw------- 1 pg pg 10485833 2012-09-14 10:03 postgres-2012-09-14_082835.log
-rw------- 1 pg pg 10485794 2012-09-14 10:03 postgres-2012-09-14_100319.log
-rw------- 1 pg pg 10485773 2012-09-14 10:03 postgres-2012-09-14_100335.log
-rw------- 1 pg pg 10485820 2012-09-14 10:04 postgres-2012-09-14_100351.log
```

- #log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'
- #log_rotation_age = 1d
- #log_rotation_size = 10MB
- don't forget to clean up!

log_rotation_age = 0 disables
log_rotation_size = 0 disables

Voila.

```
LOG:  received smart shutdown request
LOG:  autovacuum launcher shutting down
LOG:  shutting down
LOG:  database system is shut down
LOG:  database system was shut down at [whenever]
LOG:  database system is ready to accept connections
LOG:  autovacuum launcher started
```

- This is what we see when we enable logging this simple way & run the 3 examples from the beginning of the talk – notice only the restart showed up.
- There's not a lot here :) The defaults are quite conservative.
- While this is useful, it is not entirely what I want.

The Basics:
Recap

```
#log_destination = 'stderr'
logging_collector = on
#log_directory = 'pg_log'
#log_filename = 'enterprisedb-%Y-%m-%d_%H%M%S.log'
#log_rotation_age = 1d
#log_rotation_size = 10MB
#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

...now let's customize it a bit

photo © Shanti Isenagle. Used with permission.

Logging-related GUCs in postgresql.conf

- Three sections:
  - Where to Log
  - When to Log
  - What to Log
  - ...and some random locations.
- Defaults are pretty conservative
- Most parameters require pg_ctl reload; others require restart (noted in postgresql.conf)

I'm not going to discuss every single parameter, because that would be boring. I'm just going to talk about the ones that **I** like. You will probably end up with something different.

As I mentioned, the defaults are pretty conservative, so when in doubt, start with those.

You can set some of the parameters on the command-line at server start, but I don't do that.

I manage it all in postgres.conf, because changes to postgres.conf don't roll out of my command history and cause me to, say, forget where I put my logfile.

Customize:
What to Log

- who connected/disconnected
  - log_connections/log_disconnections
- what's changed
  - log_statement
- apply message prefix*
  - log_line_prefix

I think of this as the basic settings.

Remember, from my examples at the beginning, I want to know if my data or schema has changed.
I'm also kind of interested in who's connecting. (Only useful with a small user base.)
And there are some other little tidbits I want to know about who's doing what that we'll look at.

I can get all of those things by tweaking these parameters here.

Customize:
who connected

```
#log_connections = off
#log_disconnections = off

log_connections = on
log_disconnections = on
```

First up: who's connected.

Super-simple: find these params in pg.conf,
uncomment them, and set them to on.

And RELOAD.

Customize:
who connected

```
#log_connections = off
#log_disconnections = off

log_connections = on
log_disconnections = on
```

```
LOG:  connection authorized: user=gabrielle database=payroll_dev
LOG:  connection authorized: user=gabrielle database=payroll_prod
LOG:  disconnection: session time: 0:00:06.530 \
        user=gabrielle database=payroll_dev host=[local]
LOG:  disconnection: session time: 0:00:34.283 \
        user=gabrielle database=payroll_prod host=[local]
```

This is what we get. Notice what's included here.

Customize:
what's changed

```
#log_statement = 'none'          #none, ddl, mod, all
log_statement = 'mod'
```

What about the changes to my data? We do this with log_statement.
Default is none; no statements are being logged.
ddl = data definition language changes: updates to your schema – stuff like ALTER TABLE, DROP TABLE.
mod = data modification – your INSERTs, UPDATEs, and DELETEs. PLUS ddl.
all = everything. SELECTS, etc. You probably don't want that right off the bat.

So I set this to mod, so I see both the data change example and the schema change example.

If I had this set to ddl, I would have seen only the schema change example.

We're still missing some important information – like which database these commands are being executed in. We could probably piece it together with info from log_connections (previous slide), but since those probably aren't the only queries and users in your database, we'll do something else that's easier.

Customize:
what's changed

```
#log_statement = 'none'          #none, ddl, mod, all
log_statement = 'mod'
```

```
LOG:  statement: UPDATE employees
        SET salary = (salary/5)
        WHERE emp_name = 'Magnus Hagander';
LOG:  statement: DROP TABLE employees;
```

Customize:
add a message prefix

```
#log_line_prefix = ''   # special values:
                        #   %a = application name
                        #   %u = user name
                        #   %d = database name
                        #   %r = remote host and port
                        #   %h = remote host
                        #   %p = process ID
                        #   %m = timestamp with milliseconds
                        #   %e = SQL state
                        ...
                        #   %% = '%'


log_line_prefix = '%t <%d %u %r> %%'
```

A message prefix just adds some extra info to the message. There are a lot of options available; this isn't all of them, just a few of my favorites.

And here's what I use.

Customize:
add a message prefix

```
log_line_prefix = '%t <%d %u %r> %%'

2011-03-12 21:23:22 PDT <payroll_dev gabrielle 10.88.8.7(62387)> %LOG:
    statement: UPDATE employees
    SET salary = (salary/5)
    WHERE emp_name = 'Magnus Hagander';
2011-03-12 21:23:47 PDT <payroll_prod gabrielle 10.88.8.7(62387)> %LOG:
    statement: DROP TABLE employees;
```

This is what it looks like in action.

Note that we can now tell which database each qeury ran on.

You will want to work out your own, and this may be influenced by which log parsing tool you use (if any).

Except for a couple of examples, I'm not going to show these for the rest of the presentation because it takes up a lot of room. Imagine they are still there.

Customize:
resolve the hostname

```
log_line_prefix = '%t <%d %u %r> %%'

2011-03-12 21:23:22 PDT <payroll_dev gabrielle 10.88.8.7(62387)> %LOG:
    blahblahblahmessage
```

```
log_line_prefix = '%t <%d %u %r> %%'
#log_hostname = off
log_hostname = on

2011-03-12 21:23:22 PDT <payroll_dev gabrielle fabio(62387)> %LOG:
    blahblahblahmessage
```

log_hostname works in conjunction with log_connections and/or the %r param to log_line_prefix. It's not going to do you any good if you don't have one or the other of those configured as well.

Default is off; just like the other params we've been looking at, uncomment it, set it to 'on', and reload.

This is what the same message would look like with log_hostname enabled.

There will be additional overhead, which you may notice under heavy load.

Customize:
What to log recap

```
# - What to Log -
log_connections = on
log_disconnections = on
log_statement = 'mod'
log_line_prefix = '%t <%d %u %r> %%'
```

So, to sum up:
log_connections and disconnections tell me who's logging in to what database
I have my log_statement set to a value that tells me about both schema and data modifications
I have my log_line_prefix set to tell me other releveant info. Yours will be different

Customize:
When to Log

- message levels
  - log_min_messages
  - client_min_messages
  - log_min_error_statement
- long queries
  - log_min_duration_statement

This is where we decide what level of messages we want. Do we want to know only about ERRORs, or maybe NOTICEs too?

We can also do some investigation into queries that may need optimization.

These (top 3) are the most confusing parameters I worked with. So, again, don't get discouraged.

Customize:
Message Levels

Let's talk about the levels first.

DEBUG, INFO, NOTICE, WARNING, ERROR,
LOG, FATAL, PANIC.
(or something like that.)

This is for log_min_messages, others are slightly different but the important thing to grasp is that they go in order from least to greatest importance.

”Hi, I inhaled” vs ”My hair is on fire”.

When you log at a level of lesser importance (eg NOTICE), you automatically get all the more important levels, too (WARNING, ERROR, etc.)

The level for each message is set within postgres. If you don't agree with them, sorry.

Customize:
log_ and client_min_messages, log_min_error_statement

```
#log_min_messages = warning      # what gets sent to your log
#client_min_messages = notice    # what gets sent to your client
#log_min_error_statement = error # SQL message level
```

the defaults are probably fine.

When I was experimenting with these, I wrote a script of statements I wanted logged vs not logged, and changed one of the params at a time, ran my script, and see if I got what I wanted.

Customize:
Long Queries

```
#log_min_duration_statement = -1
log_min_duration_statement = 2000 # 2 seconds
log_min_duration_statement = 2s   # also 2 seconds

looks like:
LOG:  duration: 2360.958 ms  statement:
  SELECT blahblahblah FROM woof_woof_moo_moo;
```

let's capture some queries.

log_min_duration_statement logs any statement that runs longer than however many milliseconds I've put in here. For example, if I run a SELECT that takes 3 minutes, I'll get a log message stating that I had a query of [x] duration, *plus* the actual SQL statement. You can also specify units here, so you don't have to work out the math of how many milliseconds there are in, say, 10 minutes.

If you set this to 0, it will log *everything*. -1 disables it (that's the default).

And guess what? This interacts with log_statement (back in our basic ”what to log” section.)

log_statement + log_min_duration_statement

```
log_statement = 'mod'
log_min_duration_statement = 2s
log_line_prefix = '<%d %u %r %p> %%'

Looks like:
<testy toadie [local] 25783> % LOG:  duration: 2562.006 ms
<testy toadie [local] 25783> % LOG:  statement: INSERT INTO table VALUES...
```

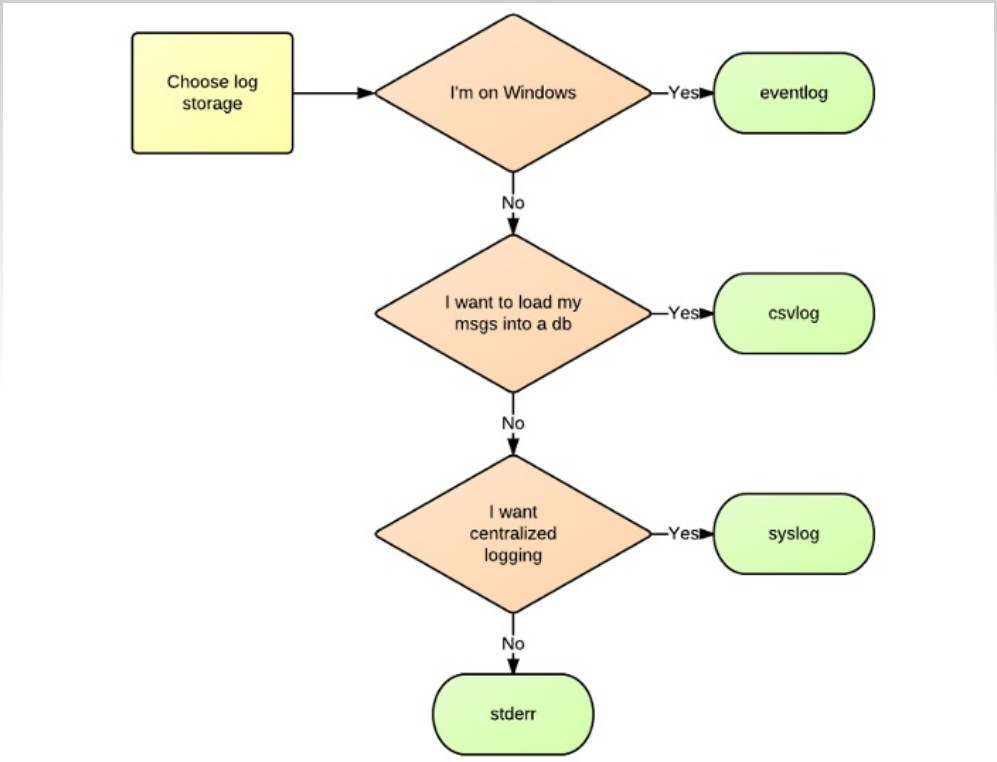
You don't have to have log_statement enabled in order to use log_min_duration_statement.

Conversely, if you have a statement that would be logged by both (in our case, an INSERT [which falls under the 'mod' value in log_satement] that takes longer than 2s) - the query WILL NOT be printed by log_min_duration_statement, only the timing.

- this is where log_line_prefix comes in. One of the things you can specify in log_line_prefix is a pid, which you can then use to match up stuff from log_min_duration_statement that overlaps with log_statement.
- you may want to just choose one or the other of log_statement and log_min_duration statement.

Customize:
Where to log

- You have four choices:
  - eventlog
  - csvlog
  - syslog
  - stderr



Made with LucidChart. Grossly oversimplified. Not for production use.

Customize:
eventlog (Windows)

- get service start/stop messages by default
- edit postgresql.conf
- restart via Services menu OR
  - reload via PgAdmin
- use Event Viewer to view
  - set up a custom filter to reduce annoyance

More help? see me afterwards or at the code sprint.

Customize:
stderr (review)

```
#log_destination = 'stderr'

#logging_collector = off        #requires restart
logging_collector = on

#log_directory = 'pg_log'
#log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'

#log_rotation_age = 1d
#log_rotation_size = 10MB
log_rotation_size = 0

#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

We'll start with a basic stderr setup here, because it's the easiest - Pg handles all the details for you. In fact, if you enabled only logging_collector, you are already using it.

Put the log wherever you want; name it whatever you want.

Pg handles the log rotation for you.

Log rotation – keeps your logs from growing out of control. Existing log is saved to a different file, truncated, and starts clean.

Customize:
stderr

- make sure the pg user has perms on the log directory, otherwise:

```
FATAL:  42501: could not create log file
"/home/gabrielle/fooled-ya.log": Permission denied
```

- ...and the database won't start.

The only thing you have to make sure of is that the postgres user has the correct perms on the log directory. You will find out pretty quickly if not.

Customize: stderr

- Pros:
  - easy!
  - Pg handles the log rotation for you
- Cons:
  - you need to ship logs yourself to a central server
  - you need to clean up old logs yourself

pros: easy, pg handles log rotation
cons: if you want centralized logging, you need to figure out a way to get your logs to your log server; you need to clean them up. But that's not that hard.

cleanup...

```
#!/usr/bin/bash

LOG_DIR=/usr/local/pgsql/logs
FIND=/usr/bin/find
AGE=6 # "today" counts as 0;
      # this gives me 8 days' worth of logs

${FIND} ${LOG_DIR}/ \
-name "postgresql.log.*" \
-mtime +6 \
-exec rm -f {} \;
```

You can write a shell script.

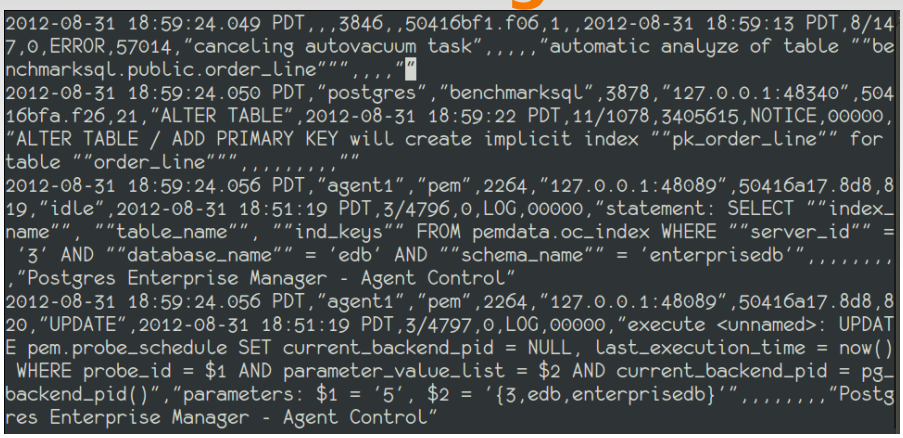
I am not responsible if you use this and it breaks something.

Customize:
csvlog

```
#log_destination = 'stderr'
log_destination = 'csvlog'

#logging_collector = off        #requires restart
logging_collector = on

#log_directory = 'pg_log'
#log_filename = 'postgresql-%Y-%m-%d_%H%M%S.log'

#log_rotation_age = 1d
#log_rotation_size = 10MB
log_rotation_size = 0

#log_truncate_on_rotation = off
log_truncate_on_rotation = on
```

Exactly the same as stderr, just specify 'csvlog.'

Customize:
csvlog



- log_filename = 'postgresql-[timestamp].log' but file is named postgresql-[timestamp].csv

Yum.

Customize:
csvlog

- Pros:
  - Pg handles the log rotation
  - you get a lot of cool stuff without extra effort
  - loading logs into a database is a snap!
- Cons:
  - you need to ship logs yourself to a central server
  - you need to clean up old logs yourself
  - logs are no longer human-readable
  - you may not agree with the available fields

The best thing about csvlog is that loading logs into a database for data warehousing or further analysis is a snap. We'll see that when we talk about the analysis tools.

The bad:
Personally, I don't like to read csv files with more than about two fields. And there are lots here.

Also you are stuck with what you get in terms of fields and their contents, and may have to do additional parsing.

Customize:
syslog

```
#log_destination = 'stderr'
log_destination = 'syslog'

#syslog_facility = 'LOCAL0'
syslog_facility = 'LOCAL5'

#log_line_prefix = ''
log_line_prefix = '%t <%d %u %r> %% '
```

This brings us to syslog, usually my preferred option.

Simpler to set up from the Pg side (fewer parameters here), more complicated from the system side.

You'll need to work with your sysadmin to figure out an appropriate facility. It's beyond the scope of this discussion (we can talk about it later if you want). Suffice to say, you can make a big mess if you pick the wrong one.

We'll talk about the message prefix in a couple of slides.

Customize:
syslog

- Pros:
  - centralized logging is easy
  - leverage existing systems
  - can do some fun stuff with syslog-ng
- Cons
  - requires access to syslog.conf
  - you need to provide log rotation, eg logadm.conf
    - which, conveniently, ages out old files, too.

Customize:
syslog caveats

- performance issues?
- I put a timestamp on my messages (docs recommend against that, so use at your own risk)
  - tz differences
  - ”network latency”
  - control freak

There will be additional overhead. [Note: Greg Smith's talk covers a way to partially alleviate this.]

In the previous slide I showed my log_line_prefix, which includes a timestamp. The docs specifically recommend against this to reduce overhead, but I include it anyway, even though the syslog daemon does provide its own timestamp. Mainly to have an extra data point if I'm doing timezone math. Which I hate.

Recap

```
# - What to Log -
log_connections = on
log_disconnections = on
log_statement = 'mod'
log_line_prefix = '%t <%d %u %r> %%'


# - When to Log -
#client_min_messages = notice
#log_min_messages = warning
#log_min_error_statement = error
log_min_duration_statement = 5s


# - Where to Log -
# ... you decide.
```

All righty, here's our config thus far. Again, YMMV: this may not be appropriate for your use. I encourage you to experiment!

Customize:
other stuff

- log_checkpoints
- log_autovacuum_min_duration
- log_error_verbosity

Other config parameters to be aware of, once you're comfortable with what we've covered so far.

Override a configured value from psql

```
SET log_min_duration_statement = '2min';
```

If you have THE POWER.

Check settings from psql

```
SELECT name, setting, short_desc
 FROM pg_settings
 WHERE category LIKE 'Reporting and Logging%'
 ORDER BY 1;
```

In case you forgot, and don't feel like opening up postgres.conf...

Tools

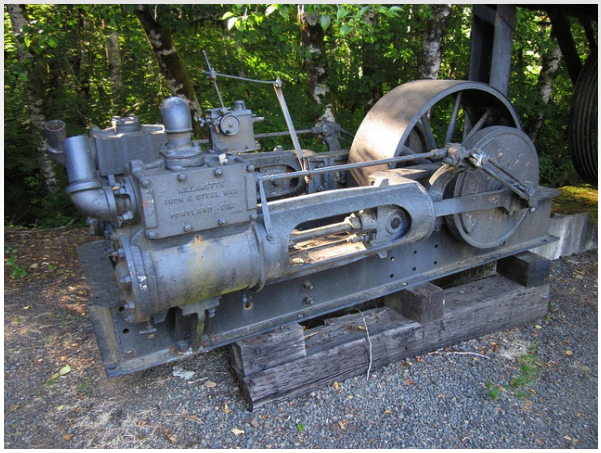


photo Dougtone (flickr). Creative Commons license.

OK, I have logs. Now what.

- use your eyeballs!
- ...and Unix utils
  - tail, grep, sed, cut, awk, split -l
- throw it into a db
  - csvlog makes this easy
- automated reporting
  - roll your own
  - generic: splunk, logstash, etc
  - pg-specific: pgfouine, pgbadger

You can read them. If you're a masochistic insomniac.

Look at them **before** you start having a problem. Get a grip on what ”normal” looks like for you. Also, you will likely have to look for something in the raw logs at some point in time – get yourself familiar with the environment now.

If you find stuff, fix it. You don't want to have to remember at 2am that 'Oh, yeah, those 3000 error messages we get every night are normal.'

Start out with the basic Unix utils for parsing files and see what's what.

Of course you could just throw it into a database or use some other reporting tools available.

Tools:
csvlog -> database

- create a table (see the docs)
  - ”application field” added in 9.0
- `COPY 'my.log' TO log_table WITH CSV;`
- profit!
- pros:
  - disgustingly simple – **best for automated parsing**
  - you get a lot of cool stuff (pid, timestamp, SQL state code) automatically
- cons:
  - raw logs are not human-readable
  - don't get to choose your fields

FNNLC*

```
loggy=# SELECT date_trunc('hour', log_time) AS hour, error_severity, count(*)
FROM postgres_log
GROUP BY hour, error_severity
ORDER BY hour, error_severity;
         hour          | error_severity | count
-----------------------+----------------+-------
 2011-03-15 09:00:00-05 | LOG            |     4
 2011-03-15 10:00:00-05 | LOG            |     1
 2011-03-15 11:00:00-05 | LOG            |     1
 2011-03-15 12:00:00-05 | LOG            |     1
 2011-03-15 13:00:00-05 | LOG            |     1
 2011-03-15 14:00:00-05 | LOG            |     1
 2011-03-15 15:00:00-05 | ERROR          |     1
 2011-03-15 15:00:00-05 | LOG            |    25
 2011-03-15 16:00:00-05 | ERROR          |     6
 2011-03-15 16:00:00-05 | LOG            |  2144
 2011-03-15 16:00:00-05 | WARNING        |   147
 2011-03-15 17:00:00-05 | LOG            |     2
```

*Friday Night No Life Club

This is just a quick sample of the sort of thing you can do – this is my log messages, grouped by severity and hour (mainly this was an excuse to use date_trunc because I love it.)

Notice I have a lot of WARNINGs coming in at 4pm? Maybe I should see what's happening then, some automated report or something.

(generic) Tools:
splunk & logstash

- www.splunk.com
- logstash.net
- Splunk costs $$$$, logstash is open-source
- Both are easy to install
- Both require some tweaking to handle Pg log

- I don't recommend setting these up just for postgres, but certainly leverage your existing systems if you already have these in place

Tools:
pgfouine

- pg log parser
- pgfouine.projects.postgresql.org
- pHp
- 8.4
- slow on larger logs

The original.

Tools:
pgbadger

- pg log parser
- https://github.com/dalibo/pgbadger
- Perl
- use this one :)

The new kid on the block.

Tools:
pgfouine/pgbadger

```
./pgfouine.php \
-file postgresql.log \
-logtype stderr \
-report testy.html=overall,bytype,
    ...n-mostfrequent,n-slowestaverage,
    ...n-mostfrequenterrors \
-format html \
-top 10
```

```
./pgbadger postgresql.log
```

Comparison of the command lines (pgbadger includes all that stuff by default.)

It's really easy to switch from fouine to badger.

Tools:
pgfouine/pgbadger

- pros:
  - decent docs
  - cron-able
  - pretty, portable reports
- cons:
  - fouine is slow for large logs (badger is faster)
  - requires specific log_line_prefix:
    - log_line_prefix = '%t [%p]'
  - can't handle multi-line messages from stderr logtype

CSS for the layout is included in each, so you can just ship the report somewhere and it won't display all weird. This makes it easy to share them with your friends!

Tools:
fouine/badger caveats

- re-format your syntax (eg, select -> SELECT)
- don't recognize some lines:

```
Unrecognized LOG or DEBUG line: LOG:  aborting any active transactions - Log line 56365
Unrecognized LOG or DEBUG line: LOG:  autovacuum launcher shutting down - Log line 56367
Unrecognized LOG or DEBUG line: LOG:  shutting down - Log line 56368
Unrecognized LOG or DEBUG line: LOG:  database system is shut down - Log line 56369
Unrecognized LOG or DEBUG line: LOG:  database system was shut down at [...]
Unrecognized LOG or DEBUG line: LOG:  database system is ready to accept [...]
Unrecognized LOG or DEBUG line: LOG:  autovacuum launcher started - Log line 56372
```

Even if it doesn't recognize the lines, it tells you instead of dying quietly.

Further tweaking

photo benfulton. Creative Commons license.

log_line_prefix:
SQL State error code (%e)

- 9.0+ (Guillaume Smet)
- 5-digit code that you can look up
  - and possibly find out a bit more about your error
- For example:

```
<22P02>ERROR:  invalid input syntax for integer: ...

<22003>ERROR:  value "4294967295" is out of range ...
```

  - 22P02 = "invalid text representation"
  - 22003 = "numeric value out of range"

This is an actual example, comparing what comes in in the logs with the actual published translation. So sometimes it will help you, sometimes it will only provide entertainment value.

per-user stats

```
ALTER USER gabrielle SET log_statement to 'all';
```

auto_explain

- contrib module - Takahiro Itagaki
- introduced in 8.4
- automatically runs EXPLAIN on every query that takes longer than a (super)user-specified value
- to install:
  - `cd /pg/src/contrib`
  - `make && make install`

auto_explain is like log_min_duration_statement on crack.

It's a contrib module and you need to install it; here are the instructions.

It logs the EXPLAIN output for any query that runs longer than a certain amount of time (which you specify). This is cool because you can have it capture EXPLAIN data for you while you're out doing something else, and review the logs at your leisure.

But be careful – this will create a lot of output! Try this in your dev environment.

auto_explain
postgresql.conf

```
shared_preload_libraries = 'auto_explain' #requires a restart
custom_variable_classes = 'auto_explain'
auto_explain.log_min_duration = '500'     #requires reload
```

Once you have it installed, here's how you configure it in postgres.conf

auto_explain
psql

```
postgres=# LOAD 'auto_explain';
LOAD
postgres=# set auto_explain.log_min_duration = 500;
postgres=# \i 'queries_that_drive_me_bonkers.sql'
```

I use it mainly from a psql session; here's how to do that. Then I just run whatever queries I want to check out. This is probably the safer way to run it than having it enabled all the time.

auto_explain

```
2010-10-11 10:24:15 PDT [11146]: [1552-1] user=markwkm,db=dbt5 LOG:  duration: 0.048 ms
plan:
        Query Text: UPDATE customer_account
        SET ca_bal = ca_bal + -11675.200000
        WHERE ca_id = 43000039241
        Update  (cost=0.00..8.28 rows=1 width=71)
          ->  Index Scan using pk_customer_account on customer_account  (cost=0.00..8.28
rows=1 width=71)
                Index Cond: ((ca_id)::bigint = 43000039241::bigint)
2010-10-11 10:24:15 PDT [11472]: [705-1] user=markwkm,db=dbt5 LOG:  duration: 12.903 ms
plan:
        Query Text: SELECT * FROM SecurityDetailFrame1(false,8,'2002-2-12','RDEN')
        Function Scan on securitydetailframe1  (cost=0.00..10.00 rows=1000 width=1080)
```

No font can adequately display EXPLAIN output, but we're going to try.

Note that you get the query text, timing, and the EXPLAIN output.

Again: this will produce a LOT of output in your logs. Keep an eye on them.

One last thing:

```
testy=# CREATE USER nimrod WITH PASSWORD 'hellothere';
LOG:  statement: CREATE USER nimrod WITH PASSWORD 'hellothere';
testy=# ALTER USER nimrod WITH PASSWORD 'whoopsie-daisy!';
LOG:  statement: ALTER USER nimrod WITH PASSWORD 'whoopsie-daisy!';
```

Instead:

```
testy=# \password nimrod
Enter new password:
Enter it again:
testy=#

LOG:  statement: ALTER USER nimrod PASSWORD 'md5f7blahblahblah'
```

Safety first (sort of)!

- Manage postgresql.conf in $vcs
  - git, svn, whatever
- Put your logs on their own partition
- Don't dink around with your settings and leave for the weekend.
- Monitor your monitoring (it's meta!)
  - especially file sizes/disk space

logs on their own partition: if you don't know what that means, talk to your sysadmin, tell them what you're trying to do, and they will help you. It is in their best interest to help you.

protip: ”don't make changes on friday afternoon.”

Which brings me to my final point – monitor your logs. You can pipe an alert to nagios. A coworker wrote a shell script that counts the number of lines in my log files and sends them to rrd so I have a graph. You want to know if your files suddenly increase dramatically in size.

That's it!

photo by kcxd (flickr). Creative Commons license.

More...

”Query Logging and Workload Analysis”

Greg Smith

19 Sep 1:30pm

Thank you!

- console font: monofur by tobias b koehler
  http://www.dafont.com/monofur.font
- PDXPUG
- Josh Heumann
- feedback welcome!
  - Code sprint on Thursday
  - gorthx@gmail.com, @gorthx