PostgreSQL Performance Troubleshooting

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(best viewed in MS Word -> View -> Web Layout)

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Step 1) Get dbstate output

Script by Abel Macias, Dimas Chbane

- Connect using psql

```
psql -h localhost
```

- List all databases

```
\l        # this list all databases

Example output:

kristofferson.a.arao=# \l
                                                 List of databases
         Name          |        Owner         | Encoding |   Collate
|    Ctype    |   Access privileges
```

```
----------------------+----------------------+----------+------------
-+-------------+-----------------------
 kristofferson.a.arao | kristofferson.a.arao | UTF8     | en_US.UTF-8
| en_US.UTF-8 |
 postgres             | postgres             | UTF8     | en_US.UTF-8
| en_US.UTF-8 |
 template0            | postgres             | UTF8     | en_US.UTF-8
| en_US.UTF-8 | =c/postgres          +
                      |                      |          |
|             | postgres=CTc/postgres
 template1            | postgres             | UTF8     | en_US.UTF-8
| en_US.UTF-8 | =c/postgres          +
                      |                      |          |
|             | postgres=CTc/postgres
(4 rows)
```

- Show current database

```
kristofferson.a.arao=# SELECT current_database();
   current_database
----------------------
 kristofferson.a.arao
(1 row)
```

- Connect to the database

```
\c <db name>    # connect to a database

Example output:

kristofferson.a.arao=# \c postgres
You are now connected to database "postgres" as user
"kristofferson.a.arao".
```

- Run the pg_dbstate.sql script

```
\i pg_dbstate.sql      # run the sql script


postgres=# \i pg_dbstate.sql
Timing is on.
Time: 1.709 ms
```

```
Time: 1.345 ms
Time: 0.192 ms
Tuples only is on.
Expanded display is on.
Time: 0.247 ms
Time: 0.470 ms
Time: 5.222 ms
Time: 3.889 ms
Time: 1.759 ms
Time: 12.733 ms
Expanded display is off.
```

- Rename the dbstate.txt to the database name

```
ls dbstate.txt pg_dbstate.sql
dbstate.txt     pg_dbstate.sql


mv dbstate.txt dbstate.txt.postgresql
```

Step 2) Get explain plan of the slow SQL

- Connect using psql

```
psql -h localhost
```

- Connect to the database

```
\c <db name>    # connect to a database

Example output:

kristofferson.a.arao=# \c postgres
You are now connected to database "postgres" as user
"kristofferson.a.arao".
```

- Run the EXPLAIN command with the slow SQL and spool to text

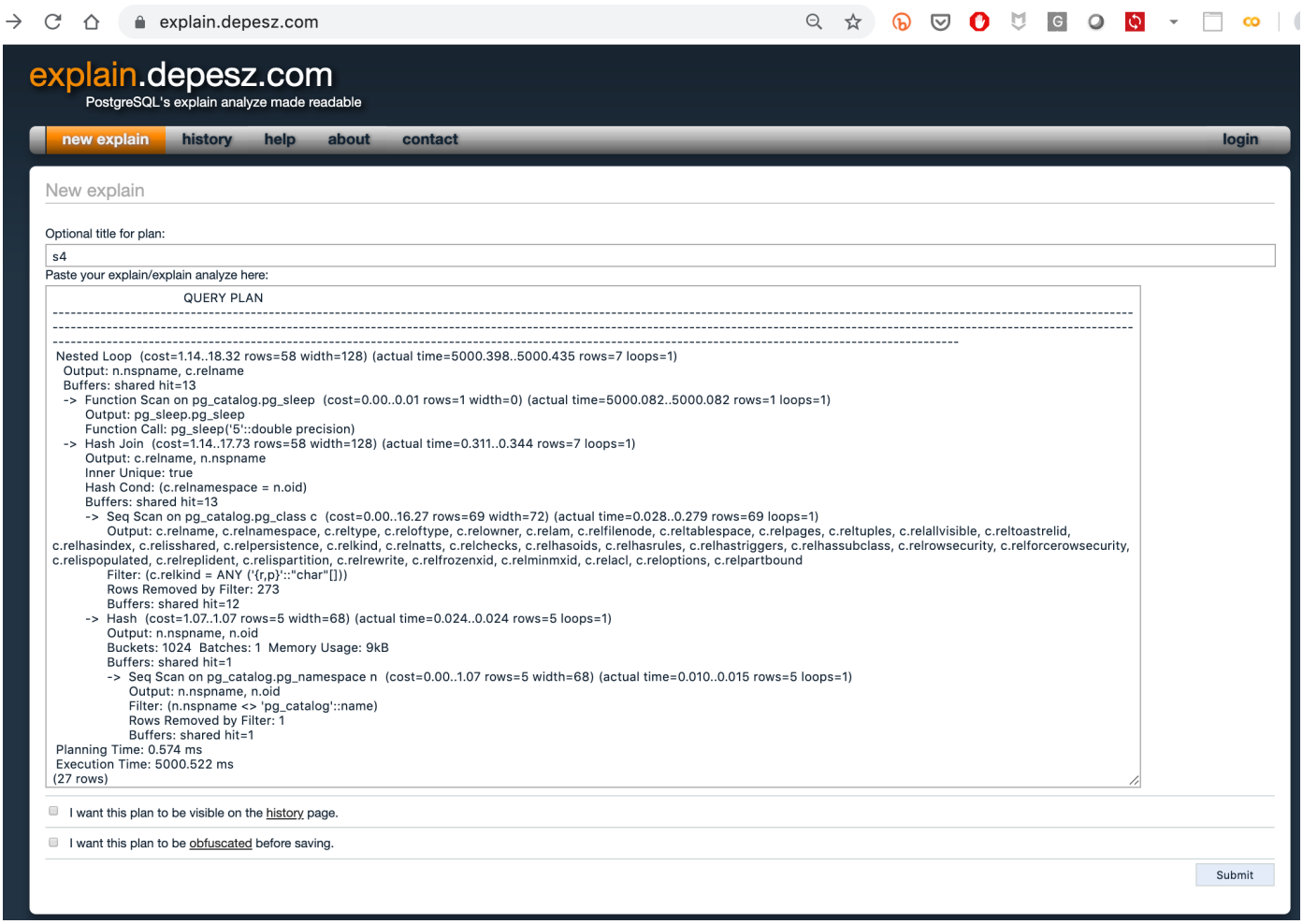
```
# example artificial slow query below with pg_sleep to 5 seconds

explain (analyze,verbose,costs,buffers, FORMAT text)  SELECT
schemaname, tablename
  FROM pg_tables, pg_sleep(5)
  WHERE schemaname <> 'pg_catalog';

# run with \o <filename> to spool to text


Example output:

postgres=# \o explain_text.txt
postgres=#
postgres=# explain (analyze,verbose,costs,buffers, FORMAT text)
SELECT schemaname, tablename
postgres-#   FROM pg_tables, pg_sleep(5)
postgres-#   WHERE schemaname <> 'pg_catalog';
postgres=#
postgres=# \o
```

- Query Plan output

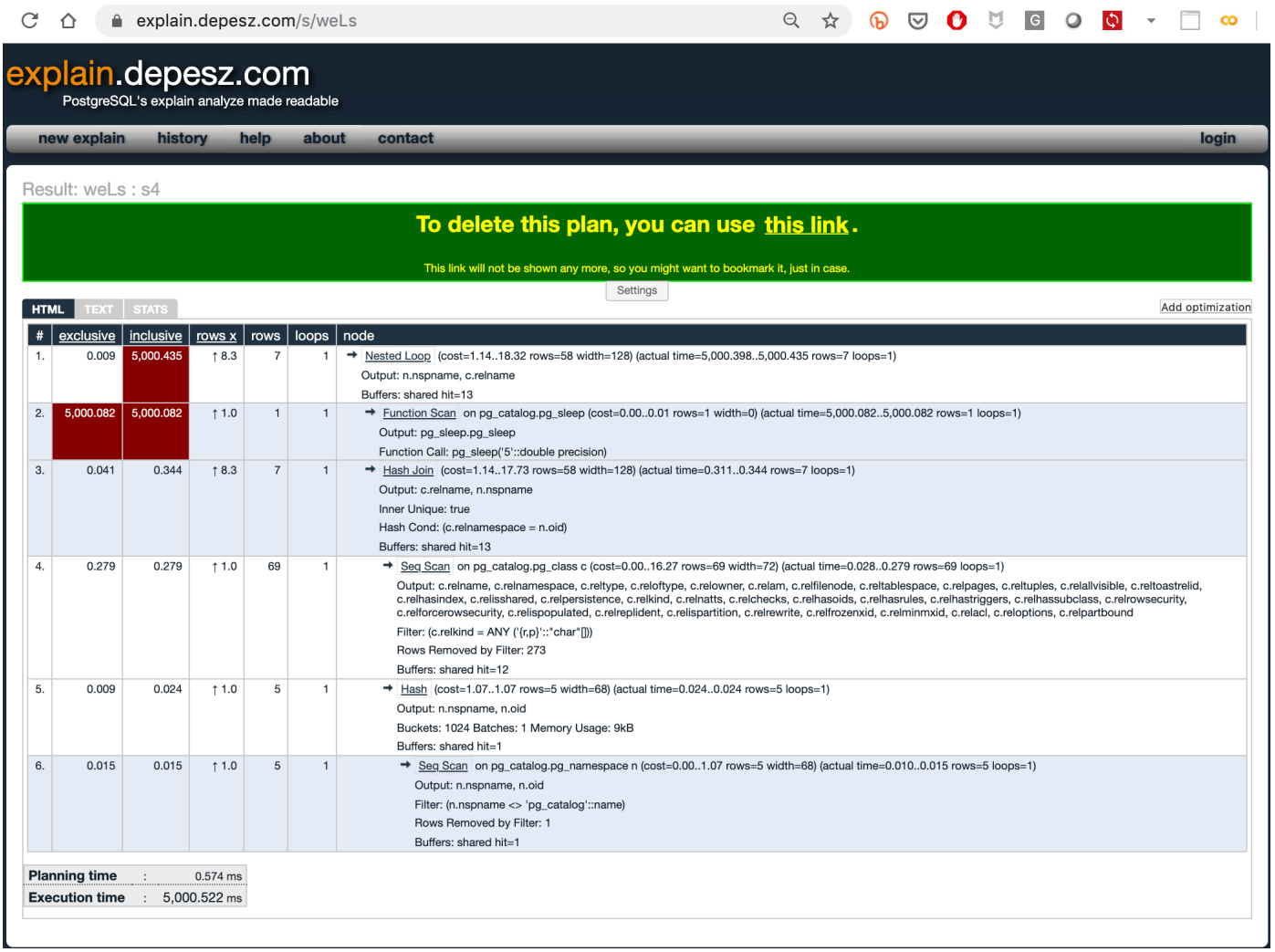
```
                                    QUERY PLAN
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
-------
 Nested Loop  (cost=1.14..18.32 rows=58 width=128) (actual time=5000.398..5000.435
rows=7 loops=1)
   Output: n.nspname, c.relname
   Buffers: shared hit=13
   ->  Function Scan on pg_catalog.pg_sleep  (cost=0.00..0.01 rows=1 width=0)
(actual time=5000.082..5000.082 rows=1 loops=1)
         Output: pg_sleep.pg_sleep
         Function Call: pg_sleep('5'::double precision)
   ->  Hash Join  (cost=1.14..17.73 rows=58 width=128) (actual time=0.311..0.344
rows=7 loops=1)
         Output: c.relname, n.nspname
         Inner Unique: true
         Hash Cond: (c.relnamespace = n.oid)
         Buffers: shared hit=13
         ->  Seq Scan on pg_catalog.pg_class c  (cost=0.00..16.27 rows=69 width=72)
(actual time=0.028..0.279 rows=69 loops=1)
               Output: c.relname, c.relnamespace, c.reltype, c.reloftype,
c.relowner, c.relam, c.relfilenode, c.reltablespace, c.relpages, c.reltuples,
c.relallvisible, c.reltoastrelid, c.relhasindex, c.relisshared, c.relpersistence,
```

```
c.relkind, c.relnatts, c.relchecks, c.relhasoids, c.relhasrules, c.relhastriggers,
c.relhassubclass, c.relrowsecurity, c.relforcerowsecurity, c.relispopulated,
c.relreplident, c.relispartition, c.relrewrite, c.relfrozenxid, c.relminmxid,
c.relacl, c.reloptions, c.relpartbound
               Filter: (c.relkind = ANY ('{r,p}'::"char"[]))
               Rows Removed by Filter: 273
               Buffers: shared hit=12
         ->  Hash  (cost=1.07..1.07 rows=5 width=68) (actual time=0.024..0.024
rows=5 loops=1)
               Output: n.nspname, n.oid
               Buckets: 1024  Batches: 1  Memory Usage: 9kB
               Buffers: shared hit=1
               ->  Seq Scan on pg_catalog.pg_namespace n  (cost=0.00..1.07 rows=5
width=68) (actual time=0.010..0.015 rows=5 loops=1)
                     Output: n.nspname, n.oid
                     Filter: (n.nspname <> 'pg_catalog'::name)
                     Rows Removed by Filter: 1
                     Buffers: shared hit=1
 Planning Time: 0.574 ms
 Execution Time: 5000.522 ms
(27 rows)
```

- Paste the explain plan to https://explain.depesz.com , click Submit



- The output will show where most of the response time is spent



A few notes:

\timing

- \timing , equivalent to SET TIME ON in Oracle to show the wall clock time on every SQL execution in psql

```
postgres=# \timing
Timing is on.

     postgres=# explain (verbose,costs,buffers, FORMAT text)  SELECT schemaname,
     tablename
     ..output snipped..
     Planning Time: 0.583 ms
      Execution Time: 5000.761 ms
     (27 rows)

Time: 5002.297 ms (00:05.002)
```

```
postgres=#
```

EXPLAIN ANALYZE + COST

- The ANALYZE option of EXPLAIN means to execute the SQL then print the query plan
- Below is query plan with (5 seconds) and without ANALYZE (1 second)

WITH ANALYZE

```
postgres=# \timing
Timing is on.
postgres=# explain (analyze,verbose,costs,buffers, FORMAT text)  SELECT schemaname,
tablename
postgres-#   FROM pg_tables, pg_sleep(5)
postgres-#   WHERE schemaname <> 'pg_catalog';

QUERY PLAN
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
------------------------------------------------------------------------------------
-------
 Nested Loop  (cost=1.14..18.32 rows=58 width=128) (actual time=5000.472..5000.519
rows=7 loops=1)
   Output: n.nspname, c.relname
   Buffers: shared hit=13
   ->  Function Scan on pg_catalog.pg_sleep  (cost=0.00..0.01 rows=1 width=0)
(actual time=5000.171..5000.172 rows=1 loops=1)
         Output: pg_sleep.pg_sleep
         Function Call: pg_sleep('5'::double precision)
   ->  Hash Join  (cost=1.14..17.73 rows=58 width=128) (actual time=0.296..0.338
rows=7 loops=1)
         Output: c.relname, n.nspname
         Inner Unique: true
         Hash Cond: (c.relnamespace = n.oid)
         Buffers: shared hit=13
         ->  Seq Scan on pg_catalog.pg_class c  (cost=0.00..16.27 rows=69 width=72)
(actual time=0.024..0.272 rows=69 loops=1)
               Output: c.relname, c.relnamespace, c.reltype, c.reloftype,
c.relowner, c.relam, c.relfilenode, c.reltablespace, c.relpages, c.reltuples,
c.relallvisible, c.reltoastrelid, c.relhasindex, c.relisshared, c.relpersistence,
c.relkind, c.relnatts, c.relchecks, c.relhasoids, c.relhasrules, c.relhastriggers,
c.relhassubclass, c.relrowsecurity, c.relforcerowsecurity, c.relispopulated,
c.relreplident, c.relispartition, c.relrewrite, c.relfrozenxid, c.relminmxid,
c.relacl, c.reloptions, c.relpartbound
               Filter: (c.relkind = ANY ('{r,p}'::"char"[]))
               Rows Removed by Filter: 273
               Buffers: shared hit=12
         ->  Hash  (cost=1.07..1.07 rows=5 width=68) (actual time=0.023..0.024
rows=5 loops=1)
               Output: n.nspname, n.oid
               Buckets: 1024  Batches: 1  Memory Usage: 9kB
```

```
               Buffers: shared hit=1
               ->  Seq Scan on pg_catalog.pg_namespace n  (cost=0.00..1.07 rows=5
width=68) (actual time=0.009..0.015 rows=5 loops=1)
                     Output: n.nspname, n.oid
                     Filter: (n.nspname <> 'pg_catalog'::name)
                     Rows Removed by Filter: 1
                     Buffers: shared hit=1
 Planning Time: 0.583 ms
 Execution Time: 5000.761 ms
(27 rows)

Time: 5002.297 ms (00:05.002)
```

WITHOUT ANALYZE

```
postgres=# explain (verbose,costs,buffers, FORMAT text)  SELECT schemaname,
tablename
postgres-#   FROM pg_tables, pg_sleep(5)
postgres-#   WHERE schemaname <> 'pg_catalog';
ERROR:  EXPLAIN option BUFFERS requires ANALYZE
Time: 2.771 ms
postgres=#
postgres=#
postgres=# explain (verbose,costs, FORMAT text)  SELECT schemaname, tablename
postgres-#   FROM pg_tables, pg_sleep(5)
postgres-#   WHERE schemaname <> 'pg_catalog';

QUERY PLAN
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
-------
 Nested Loop  (cost=1.14..18.32 rows=58 width=128)
   Output: n.nspname, c.relname
   ->  Function Scan on pg_catalog.pg_sleep  (cost=0.00..0.01 rows=1 width=0)
         Output: pg_sleep.pg_sleep
         Function Call: pg_sleep('5'::double precision)
   ->  Hash Join  (cost=1.14..17.73 rows=58 width=128)
         Output: c.relname, n.nspname
         Inner Unique: true
         Hash Cond: (c.relnamespace = n.oid)
         ->  Seq Scan on pg_catalog.pg_class c  (cost=0.00..16.27 rows=69 width=72)
               Output: c.relname, c.relnamespace, c.reltype, c.reloftype,
c.relowner, c.relam, c.relfilenode, c.reltablespace, c.relpages, c.reltuples,
c.relallvisible, c.reltoastrelid, c.relhasindex, c.relisshared, c.relpersistence,
c.relkind, c.relnatts, c.relchecks, c.relhasoids, c.relhasrules, c.relhastriggers,
c.relhassubclass, c.relrowsecurity, c.relforcerowsecurity, c.relispopulated,
c.relreplident, c.relispartition, c.relrewrite, c.relfrozenxid, c.relminmxid,
c.relacl, c.reloptions, c.relpartbound
               Filter: (c.relkind = ANY ('{r,p}'::"char"[]))
         ->  Hash  (cost=1.07..1.07 rows=5 width=68)
               Output: n.nspname, n.oid
               ->  Seq Scan on pg_catalog.pg_namespace n  (cost=0.00..1.07 rows=5
width=68)
```

```
                      Output: n.nspname, n.oid
                      Filter: (n.nspname <> 'pg_catalog'::name)
(17 rows)

Time: 1.049 ms
```

Step 3) Monitoring Postgres workload

- Download the tool at https://github.com/dbacvetkov/PASH-Viewer/archive/master.zip
    - Project page here https://github.com/dbacvetkov/PASH-Viewer

- Unzip and read the README.md

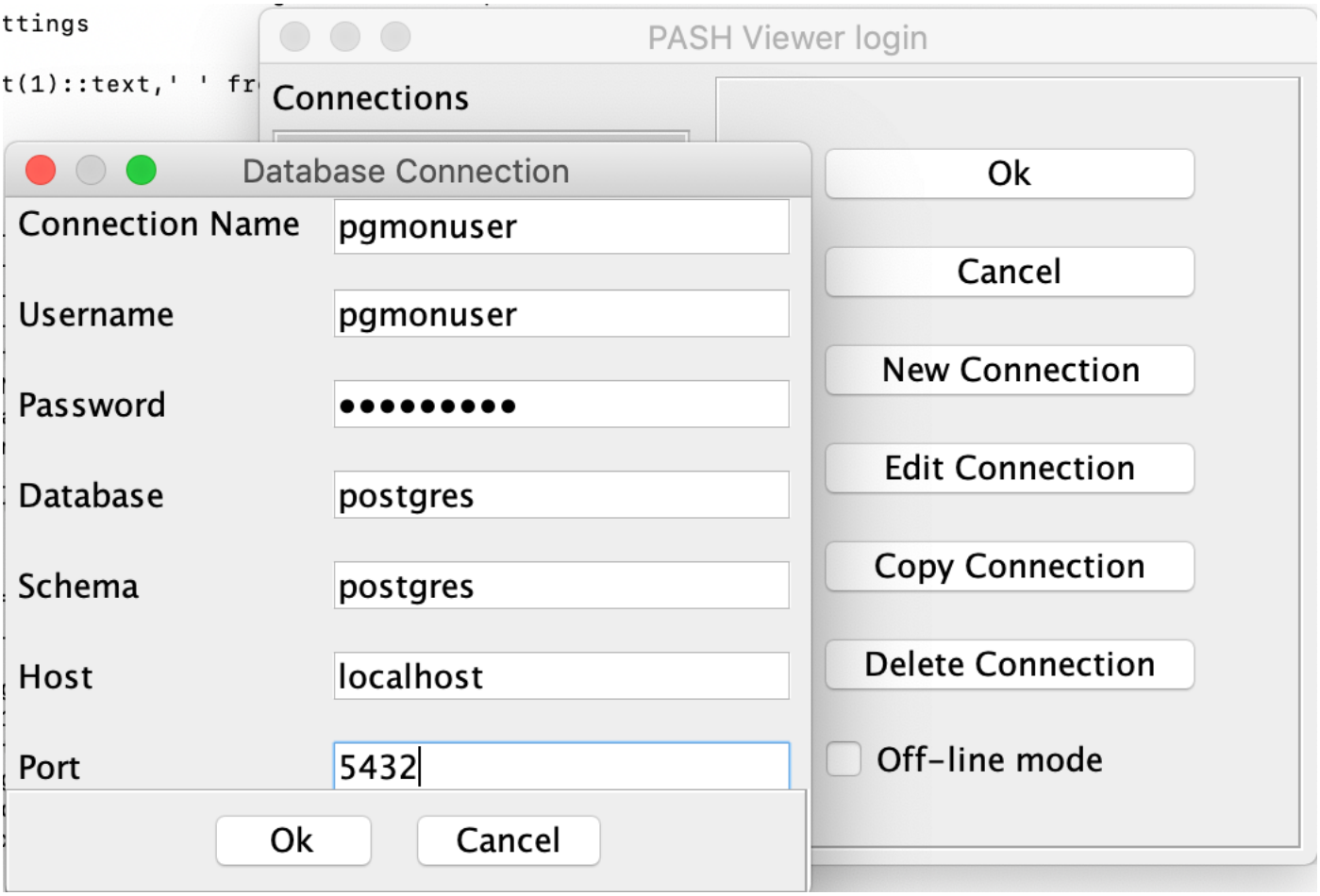
- Build the tool

```
cd /Users/kristofferson.a.arao/ash_viewer/PASH-Viewer-master

./gradlew assembleDist

cd /Users/kristofferson.a.arao/ash_viewer/PASH-Viewer-
master/build/distributions/PASH-Viewer-0.4.1/bin
```

- Create the monitoring user PGMONUSER to see query plans

```
•  from psql connect to postgres database

psql -h localhost    # psql
\c postgres          # connect to postgres

•  create the pgmonuser

postgres=# CREATE USER pgmonuser WITH password 'pgmonuser';
CREATE ROLE
postgres=# GRANT pg_monitor TO pgmonuser;
GRANT ROLE
postgres=#
```

- Enter connection details, use the PGMONUSER to connect



- Run PASH-Viewer

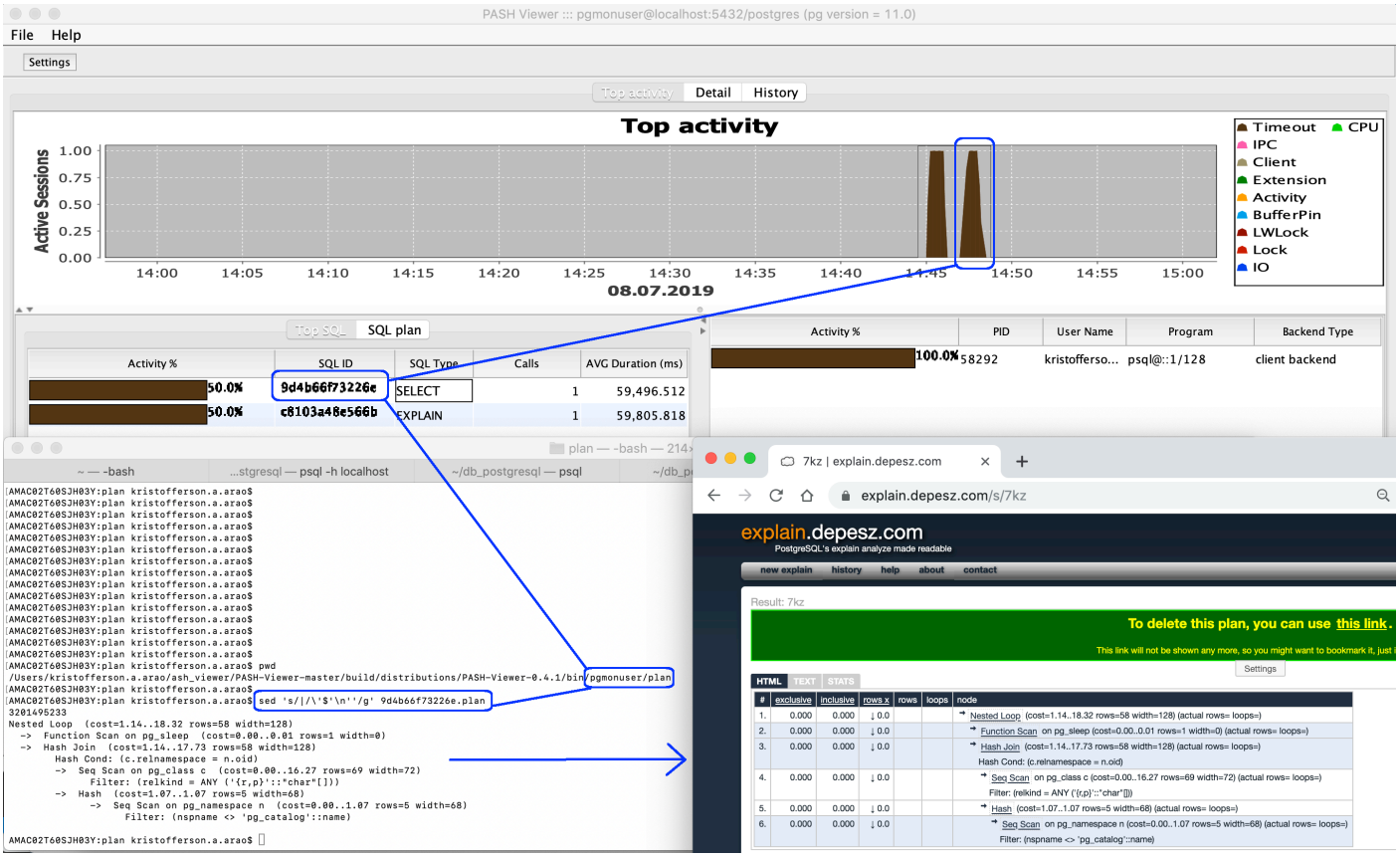
```
./PASH-Viewer
```

- The PASH-Viewer will create a directory for each connection name
- Inside the directory are two subdirectories
    - Plan directory - where SQLs and plans are stored
    - .jdb data files - for storing historical workload and raw data. This can be zipped and shared for remote troubleshooting

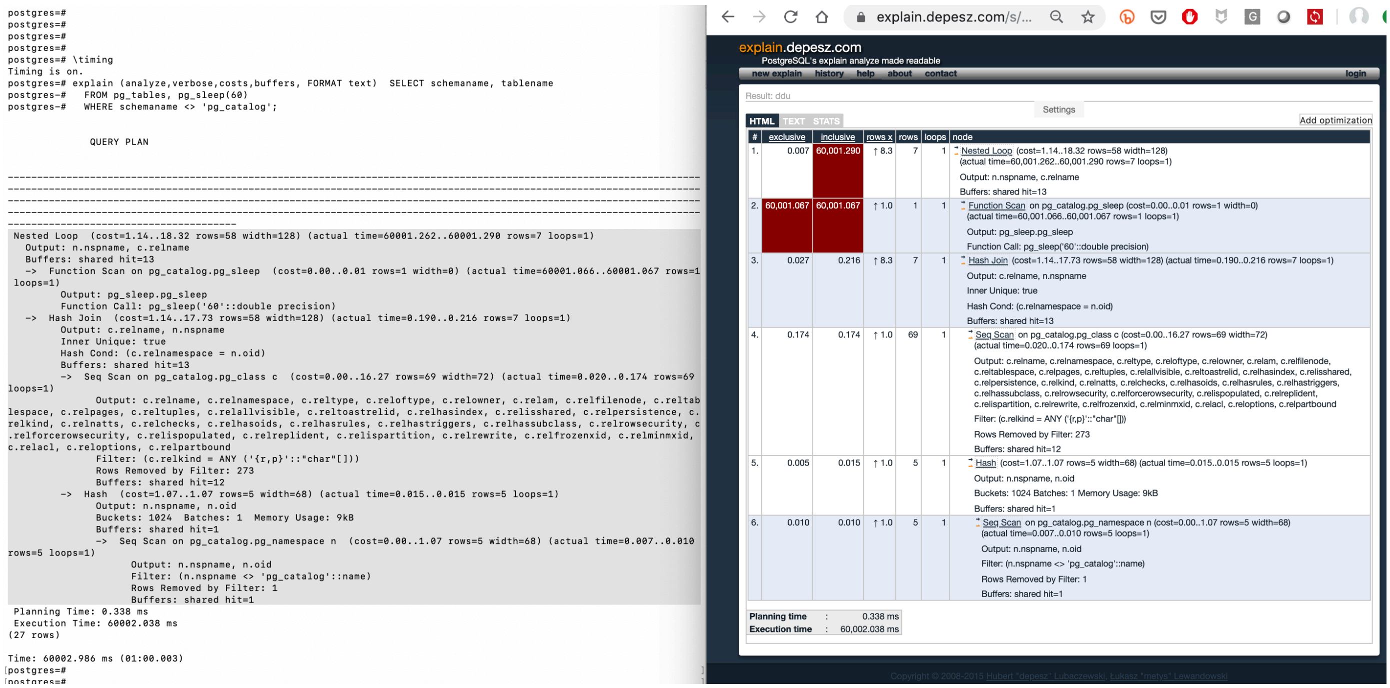
```
./PASH-Viewer

$ pwd
/Users/kristofferson.a.arao/ash_viewer/PASH-Viewer-master/build/distributions/PASH-Viewer-0.4.1/bin/pgmonuser
```

```
$ ls -ltr
total 0
drwxr-xr-x  4 kristofferson.a.arao  562225435  128 Jul  8 14:43 08072019144335
drwxr-xr-x  4 kristofferson.a.arao  562225435  128 Jul  8 14:54 plan
```

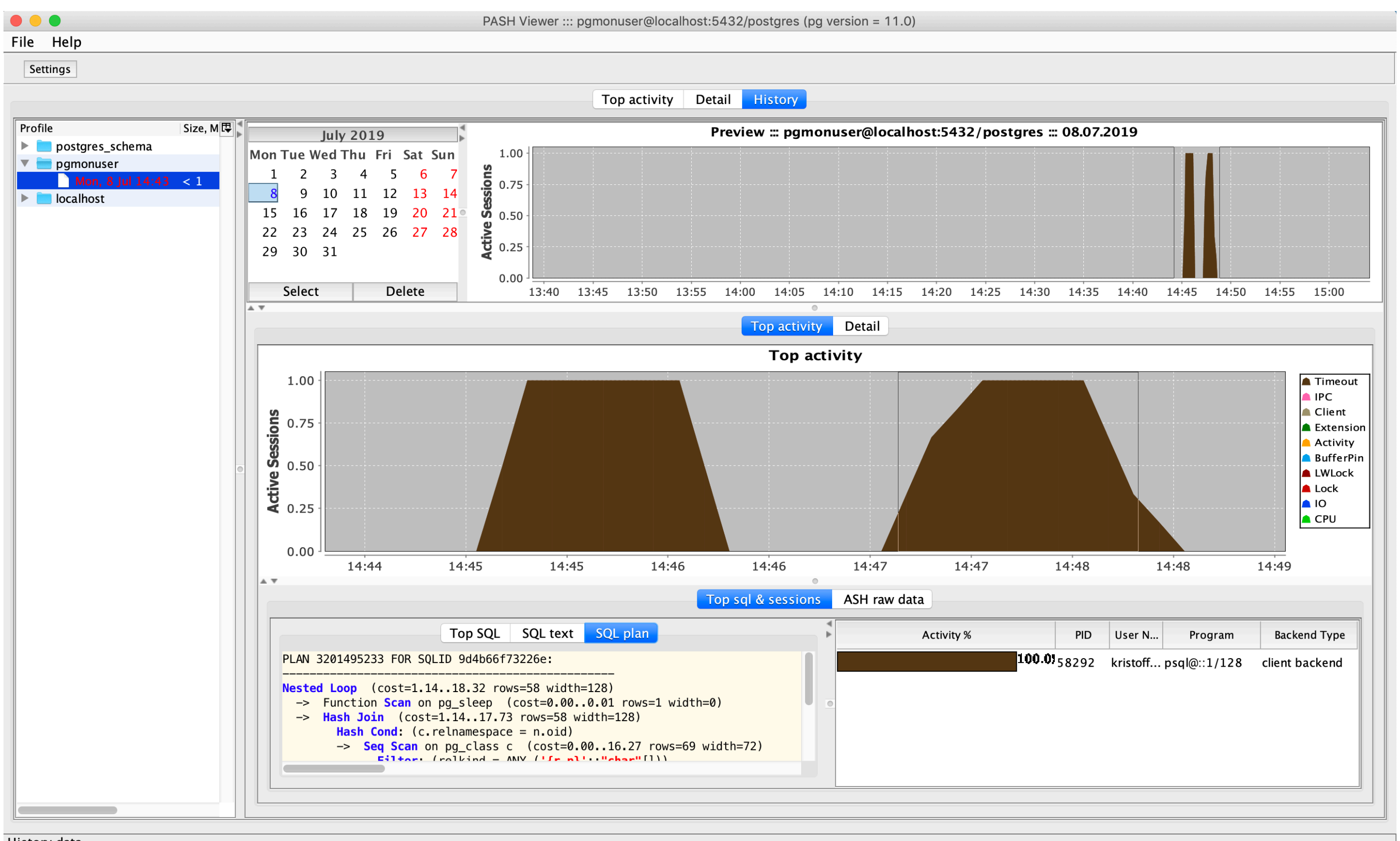
- Below correlates the database load with the running SQL and the underlying execution plan



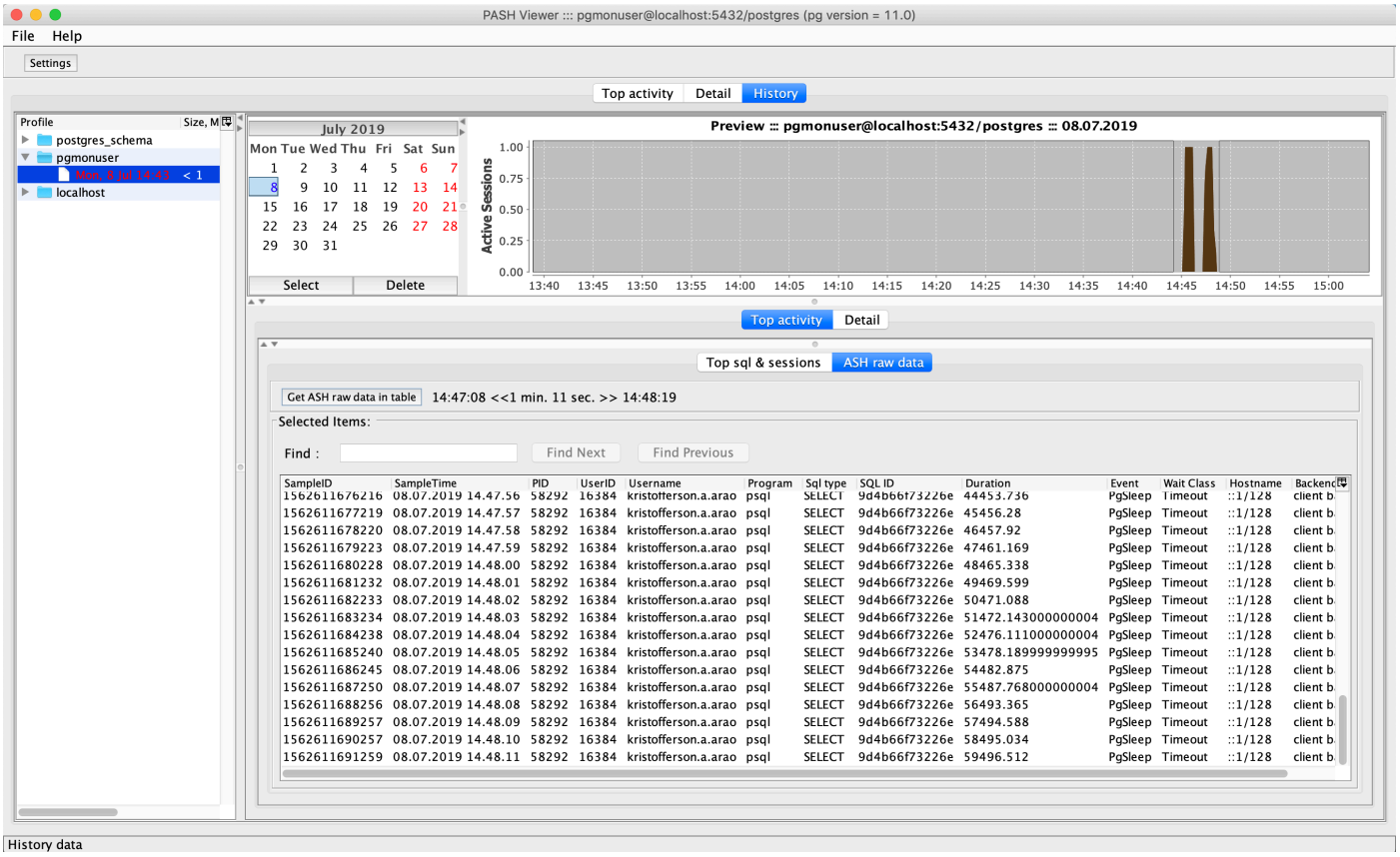
- The query plan captured by PASH-Viewer does not contain row source statistics.
- The EXPLAIN with ANALYZE and COST needs to be run on a separate session to get row source details to see where the time is mostly spent



- Historical view can be viewed using History tab



- Also raw data is available for drill down



A few notes:

Zip ASH data for remote troubleshooting

- On the PASH-Viewer base directory

```
./PASH-Viewer

$ pwd
/Users/kristofferson.a.arao/ash_viewer/PASH-Viewer-master/build/distributions/PASH-
Viewer-0.4.1/bin

$ ls -ltr
total 24
-rwxr-xr-x  1 kristofferson.a.arao  562225435  2442 Jul  8 01:56 PASH-Viewer.bat
-rwxr-xr-x  1 kristofferson.a.arao  562225435  5388 Jul  8 01:56 PASH-Viewer
drwxr-xr-x  5 kristofferson.a.arao  562225435   160 Jul  8 16:43 pgmonuser
```

- Zip the pgmonuser directory and share through email or Sharepoint URL

```
$ du -sm pgmonuser/
3    pgmonuser/

$ zip -r pgmonuser pgmonuser
  adding: pgmonuser/ (stored 0%)
  adding: pgmonuser/plan/ (stored 0%)
  adding: pgmonuser/plan/9d4b66f73226e.sql (deflated 18%)
  adding: pgmonuser/plan/9d4b66f73226e.plan (deflated 50%)
  adding: pgmonuser/08072019164333/ (stored 0%)
  adding: pgmonuser/08072019164333/00000000.jdb (deflated 92%)
  adding: pgmonuser/08072019164333/je.lck (stored 0%)
  adding: pgmonuser/08072019144335/ (stored 0%)
  adding: pgmonuser/08072019144335/00000000.jdb (deflated 91%)
  adding: pgmonuser/08072019144335/je.lck (stored 0%)

$ ls -ltr pgmonuser.zip
-rw-r--r--  1 kristofferson.a.arao  562225435  108646 Jul  8 16:45 pgmonuser.zip
```