Event Triggers

A.K.A The Real Mess.

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February, 3rd 2013

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- `pgloader`, `prefix`, `skytools`, `debian`, ...
- `CREATE EXTENSION`
- `CREATE EVENT TRIGGER`
- *Bi-Directional Réplication*
- *Partitionning*

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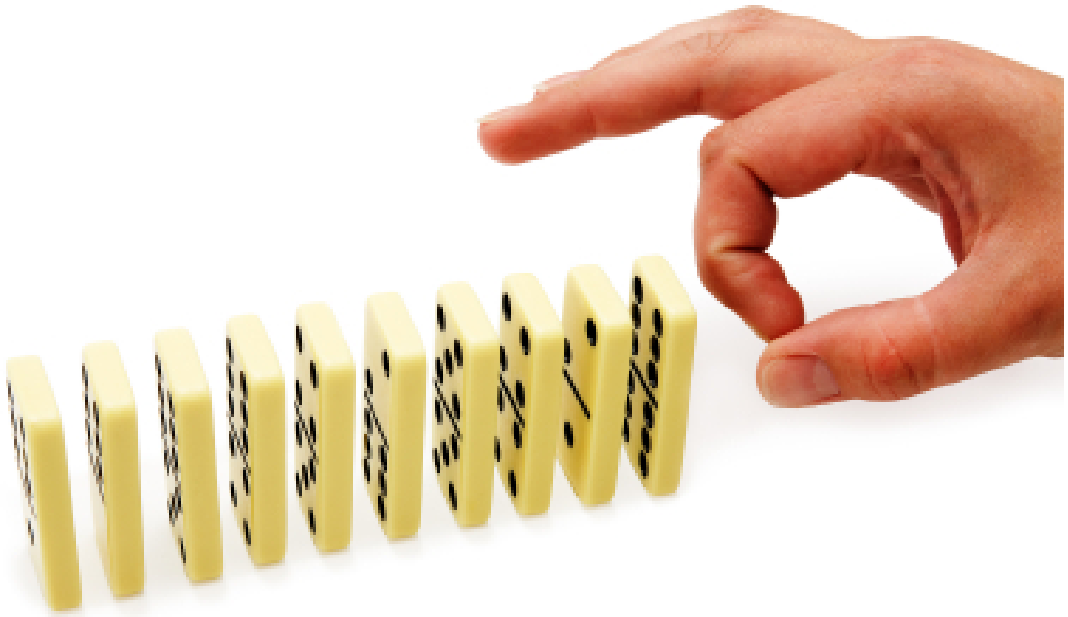
Event Triggers

So, **Event Triggers**, what do you mean?



SQL primer 1/3

It always starts *simple*

```
create table foo(a text, b int);

select a, b
  from relation r
 where a > '2013'
```

SQL primer 2/3

It always starts *simple enough*

```
create table foo(a int, b int);

select a, b
  from relation r
 where a > '2013'
```

SQL primer 3/3

It always starts *simple*... then we try handling *time*

```
create table foo(a date, b int);

select a, b
  from relation r
 where a > '2013'
```

SQL primer: Extensions

```
create extension hstore;

create table testhstore (h hstore);

select count(*)
  from testhstore
 where h @> 'wait=>CC, public=>t';
```

PostgreSQL supports Extensions

Data Type Specific Indexing and Query Support

- Functions, Aggregates, Window Functions
- Data Types with Input/Output functions
- Casts (implicit, assignment only)
- Operators
- Operator Class, Operator Family
- *and more...*

Physical Model Optimisations, Business Logic

With PostgreSQL you can tweak `INSERT`, `UPDATE`, `DELETE`

- Maintain a Materialized View
- Apply crossing threshold discounts
- Trigger external actions on some events
- `NOTIFY` some other application parts (e.g. cache)
- Queue events to process later (Use PGQ)
- Replicate data (Slony, Londiste, Bucardo...)

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Data Modification Trigger Example 1/2

```
CREATE TABLE main_table (a int, b int);

CREATE FUNCTION trigger_func()
        RETURNS trigger
       LANGUAGE plpgsql AS '
BEGIN
  RAISE NOTICE ''trigger_func(%) called: action = %, when = %,
               TG_ARGV[0], TG_OP, TG_WHEN, TG_LEVEL;
  RETURN NULL;
END;';
```

Data Modification Trigger Example 2/2

```
   CREATE TRIGGER before_ins_stmt_trig
 BEFORE INSERT ON main_table
         FOR EACH STATEMENT
EXECUTE PROCEDURE trigger_func('before_ins_stmt');

   CREATE TRIGGER after_ins_stmt_trig
  AFTER INSERT ON main_table
         FOR EACH STATEMENT
EXECUTE PROCEDURE trigger_func('after_ins_stmt');
```

SQL DDL primer

D*ata* **D***efinition* **L***anguage*

```
create table foo
 (
   id serial primary key,
   f1 text
 );

 alter table foo
  add column f2 text check (upper(f2) = f2);
```

SQL DDL primer

Here's what `foo` looks like now

```
~# \d foo
                    Table "public.foo"
 Column |  Type   |                     Modifiers
--------+---------+-----------------------------------------------
 id     | integer | not null default nextval('foo_id_seq'::reg
 f1     | text    |
 f2     | text    |
Indexes:
    "foo_pkey" PRIMARY KEY, btree (id)
Check constraints:
    "foo_f2_check" CHECK (upper(f2) = f2)
```

What if you could *tweak* DDL too

Some **DDL** Trigger use cases

- Audit trail
- Replication Triggers
- Implement Local Policies
- Divert Execution
- Limited Granting of DDL privileges with `Security Definer` trigger functions

What if you could *tweak* DDL too

Some **Event** Trigger use cases

- `sql_drop` (`CASCADE`)
- Prevent Table Rewrite (except at night) (unless full moon)
- Create Table If Not Exists, at `INSERT` time
- Integrated Extension Package Management

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Event Trigger Primer

```
CREATE OR REPLACE FUNCTION abort_any_command()
  RETURNS event_trigger
 LANGUAGE plpgsql
  AS '
BEGIN
  RAISE EXCEPTION ''command % is disabled'', tg_tag;
END;
';

CREATE EVENT TRIGGER abort_ddl ON ddl_command_start
   EXECUTE PROCEDURE abort_any_command();
```

Event Trigger Primer

Of course, the usual ALTER and DROP commands

```
ALTER EVENT TRIGGER abort_ddl DISABLE;
ALTER EVENT TRIGGER abort_ddl ENABLE replica|always;
ALTER EVENT TRIGGER abort_ddl OWNER TO bob;
ALTER EVENT TRIGGER abort_ddl RENAME TO assimilated;

DROP EVENT TRIGGER abort_ddl;
```

Events

Limited Number of Events Supported now

- `ddl_command_start`
- `ddl_command_end`
- `sql_drop` *currently in review*

Tags 1/3

```
~# create table bar(a int, b int);
CREATE TABLE

~# create function add1(int) returns int
   language sql as 'select \$1+1';
CREATE FUNCTION

~# drop function add1(int);
DROP FUNCTION
```

Tags 2/3

```
create function test_event_trigger()
        returns event_trigger as '
BEGIN
    RAISE NOTICE ''test_event_trigger: % %'', tg_event, tg_tag
END
' language plpgsql;

create function test_event_trigger_drop_function()
        returns event_trigger as '
BEGIN
    drop function test_event_trigger() cascade;
END
' language plpgsql;
```

Tags 3/3

And now let's have some fun

```
create event trigger drop_test_b on "ddl_command_start"
   execute procedure test_event_trigger();

create event trigger drop_test_a on "ddl_command_start"
    when tag in ('create table')
   execute procedure test_event_trigger_drop_function();

create table event_trigger_fire1 (a int);
```

Event Triggers Information

Currently given as magic variables available in PLpgSQL

We have

- TG_EVENT
- TG_TAG

We want to add

- TG_OPERATION
- TG_OBTYPENAME
- TG_OBJECTID
- TG_OBJECTNAME
- TG_SCHEMANAME

What about *generated* commands?

Current proposal is TG_CONTEXT. See the worked out tracking examples at http://www.postgresql.org/message-id/m2han7xyzp.fsf@2ndQuadrant.fr

```
create event trigger track_table on ddl_command_trace
    when tag in ('create table', 'alter table', 'drop table')
 and context in ('toplevel', 'generated', 'subcommand')
execute procedure public.track_table_activity();
```

Command String Normalisation 1/4

And still some more

```
create schema baz
  authorization dim

  create table distributors
    (
     did  serial primary key,
     name varchar(40),
     f2   text check (upper(f2) = f2),

     unique(name) with (fillfactor=70)
    )
    with (fillfactor=70);
```

Command String Normalisation 2/4

```
NOTICE:  snitch event: ddl_command_end, context: GENERATED,
         tag: CREATE SEQUENCE, operation: CREATE,
        type: SEQUENCE
NOTICE:  oid: 41633, schema: baz, name: distributors_did_seq
NOTICE: command: CREATE SEQUENCE baz.distributors_did_seq;

NOTICE:  snitch event: ddl_command_end, context: SUBCOMMAND,
         tag: CREATE TABLE, operation: CREATE, type: TABLE
NOTICE:  oid: 41635, schema: baz, name: distributors
NOTICE: command: CREATE TABLE baz.distributors
 (did integer,
  name pg_catalog.varchar,
  f2 text,
  CHECK ((upper(f2) = f2))) WITH (fillfactor=70);
```

Command String Normalisation 3/4

```
NOTICE:  snitch event: ddl_command_end, context: GENERATED,
         tag: CREATE INDEX, operation: CREATE, type: INDEX
NOTICE:  oid: 41643, schema: baz, name: distributors_pkey
NOTICE: command: CREATE UNIQUE INDEX distributors_pkey
                 ON baz.distributors USING btree (did);

NOTICE:  snitch event: ddl_command_end, context: GENERATED,
         tag: CREATE INDEX, operation: CREATE, type: INDEX
NOTICE:  oid: 41645, schema: baz, name: distributors_name_key
NOTICE: command: CREATE UNIQUE INDEX distributors_name_key
                 ON baz.distributors USING btree (name)
                 WITH (fillfactor=70);
```

Command String Normalisation 4/4

```
NOTICE:  snitch event: ddl_command_end, context: GENERATED,
         tag: ALTER SEQUENCE, operation: ALTER, type: SEQUENCE
NOTICE:  oid: 41633, schema: baz, name: distributors_did_seq
NOTICE: command: ALTER SEQUENCE baz.distributors_did_seq
                 OWNED BY baz.distributors.did;

NOTICE:  snitch event: ddl_command_end, context: TOPLEVEL,
         tag: CREATE SCHEMA, operation: CREATE, type: SCHEMA
NOTICE:  oid: 41632, schema: <NULL>, name: baz
NOTICE: command: CREATE SCHEMA baz AUTHORIZATION dim;

CREATE SCHEMA
```

TG_CONTEXT

How to get at *generated* commands?

PRO

- consider them DDLs
- ProcessUtility()
- `ProcessUtilityContext`

CONS

- the user didn't type a command
- clean up the code
- it's another kind of event

Next features

Some features are still on the *todo* list

- `INSTEAD OF`
- *table rewrite*
- *create table on insert*
- *add column on update*

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Instead Of Event Triggers 1/2

```
create event trigger my_create_extension
          instead of 'create extension'
   execute procedure my_create_extension();
```

Instead Of Event Triggers 2/2

```
create function my_create_extension()
        returns event_trigger
       language plpgsql
as '
begin
   alter event trigger my_create_extension disable;
   -- do some stuff here
   create extension tg_objectid;
   -- do some more stuff here, presumably
end;
';
```

Conclusion

Any Question? Now is the time to ask!