When PostgreSQL Can't, You Can

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OmniTI, Inc

- Full-stack support for high-traffic websites & applications
  - Millions of users
  - Terabytes of data
  - Gilt Groupe, Etsy, Ora.TV, Freelotto
- Surge Conference - http://omniti.com/surge
  - Disaster Porn
  - Annually in Sept
- We're hiring!

PG Extractor

- pg_dump/pg_restore limitations (-t, -n, -P)
- Filter by schema, table, view, function, type, owner
- Dumps each database object to its own file
- Use regex matching
- Python class (requires python 3)

Extensions

- Introduced in 9.1
- Logically grouped set of database objects
  - CREATE EXTENSION pg_partman [SCHEMA partman];
- Versioned
  - ALTER EXTENSION pg_partman UPDATE TO '1.6.1';
  - Update and revert changes predictably.

PG Jobmon

- Autonomous functions
- Log steps of running function
- Monitors logged functions to ensure they complete
- If/when they fail, where and why

PG Jobmon

```
add_job('job name');

add_step(job_id, 'What this step will do');
        … do some stuff...
update_step(step_id, 'good_status', 'What this step did successfully');

add_step(job_id, 'What this next step will do');
        ...do some stuff in a loop...
        update_step(step_id, 'good_status', 'update every loop iteration to track progress');

add_step(job_id, 'One last step');
        … do just a bit more stuff...
update_step(step_id, 'good_status', 'Job finished ok');

close_job(job_id);

EXCEPTION
        WHEN OTHERS THEN
                update_step(step_id, 'bad_status', 'Uh..oh...: '||coalesce(SQLERRM,'wat'));
                fail_job(job_id);
```

PG Jobmon

show_job('my job name', [int]);

```
-[ RECORD 3 ]----------------------------
job_id     | 10
owner      | keith
job_name   | PG_JOBMON TEST BAD JOB
start_time | 2012-09-15 00:55:44.742176-04
end_time   | 2012-09-15 00:55:44.851514-04
status     | CRITICAL
pid        | 5848
-[ RECORD 4 ]----------------------------
job_id     | 9
owner      | keith
job_name   | PG_JOBMON TEST GOOD JOB
start_time | 2012-09-15 00:55:44.293575-04
end_time   | 2012-09-15 00:55:44.725483-04
status     | OK
pid        | 5848
```

show_job_like('I forgot my job's whole name', [int]);

show_detail(job_id);
show_detail('job_name', [int]);

show_job_status('bad_status', [int]);
show_job_status('job name', 'status', [int]);

show_running([int]);

```
-[ RECORD 1 ]+----------------------------
job_id       | 9
step_id      | 19
action       | Test step 1
start_time   | 2012-09-15 00:55:44.501825-04
end_time     | 2012-09-15 00:55:44.593389-04
elapsed_time | 0.091564
status       | OK
message      | Successful Step 1
-[ RECORD 2 ]+----------------------------
job_id       | 9
step_id      | 20
action       | Test step 2
start_time   | 2012-09-15 00:55:44.643017-04
end_time     | 2012-09-15 00:55:44.659336-04
elapsed_time | 0.016319
status       | OK
message      | Rows affected: 2
-[ RECORD 3 ]+----------------------------
job_id       | 9
step_id      | 21
action       | Test step 3
start_time   | 2012-09-15 00:55:44.692518-04
end_time     | 2012-09-15 00:55:44.7087-04
elapsed_time | 0.016182
status       | OK
message      | Successful Step 3
```

PG Jobmon

check_job_status(interval);

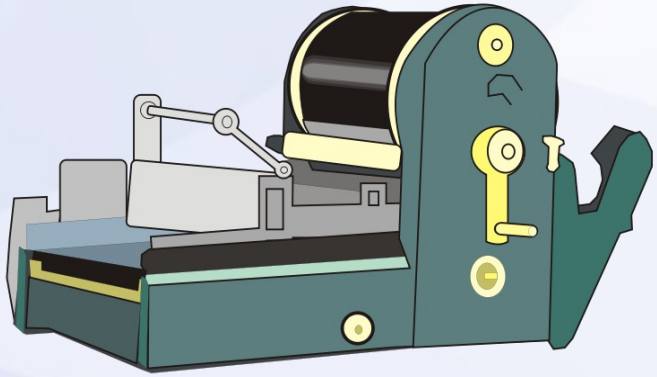
- **Make nagios check (command and service configs on my blog)**
- **Shameless plug – http://circonus.com (howto on my blog)**

```
SELECT t.alert_text || c.alert_text AS alert_status
FROM jobmon.check_job_status() c
JOIN jobmon.job_status_text t ON c.alert_code = t.alert_code;

         alert_status
------------------------------
 OK(All jobs run successfully)

                      alert_status
-------------------------------------------------------------
CRITICAL(KEITH.SOME_OTHER_PROCESS: MISSING - Last run at 2012-09-13
07:17:07.86378-04; KEITH.ANOTHER_PROCESS: MISSING - Last run at 2012-09-13
07:16:30.169683-04;)

                       alert_status
-------------------------------------------------------------
 WARNING(KEITH.SOME_CRITICAL_PROCESS: RUNNING; )
```

Mimeo

Per-table Replication Extension

*“The stencil duplicator or mimeograph machine (often abbreviated to mimeo) is a **low-cost** printing press that works by forcing ink through a stencil onto paper...Mimeographs were a common technology in printing **small quantities**, as in office work, classroom materials, and church bulletins.” – Wikipedia*



Mimeo

- Streaming & Log Shipping Replication (omnipitr)
- Per-table replication
  - Snapshot
  - Incremental
  - DML
- Quick replication setup and tear-down
- Installed & run from destination database.
- No superuser required
- Column filter
- Where Condition
- Monitor & Audit Trail w/ PG Jobmon

Types of Replication

- Snapshot
  - Whole table replication
  - Two tables w/ single view
    - Minimize transactional lock during data migration
    - Brief exclusive lock to swap view source
  - Ideal for small or static tables
  - Faster than DML replay if majority of table changes often
  - Replicate column changes (new, dropped, type)
  - No replication if source data has not changed
- Table
  - Single table, no views
  - Options to handle FK (cascade) and reset sequences
  - Good for dev database

Types of Replication

- Incremental
  - Control timestamp column (serial in dev)
  - High transaction tables w/ timestamp set every insert
  - With primary/unique key, can also support updates
  - DST
    - Run database in GMT/UTC
    - Replication does not run

Types of Replication

- DML
  - Replay Inserts, Updates, Deletes
  - Trigger w/ queue table on source
  - Doesn't actually replay
    - Queue table of only primary/unique key values for every write
    - Distinct on queue table
    - Delete all matches on destination & re-insert
  - Supports multiple destinations

Types of Replication

- Log Deletes
  - Same methods as DML but does not replay deletes
  - Common in data warehousing
  - Queue table stores entire row if it's deleted
  - Destination has special column with timestamp of row's deletion

Use Cases

- Table audit
  - Trigger to track all changes to audit table w/ audit_timestamp column
  - Use incremental replication on audit table to pull to data warehouse.
  - Time-based partitioning on source audit table to easily drop old data with minimal impact on production.
- Database Upgrade
  - Can connect with dblink to any version that supports it
  - Setup replication for larger tables to minimize downtime for pg_dump upgrade method.

PG Partition Manager

- Current partition management is entirely manual
  - http://www.postgresql.org/docs/current/static/ddl-partitioning.html
- Custom write all tables, triggers, functions, rules, etc.
- Core devs working on getting it built in
  - https://wiki.postgresql.org/wiki/Table_partitioning
- In the mean time ...

Automated Creation

- Time & Serial Based Partitioning
  - Yearly, Quarterly, Monthly, Weekly, Daily, Hourly, ½ hour, ¼ hour
  - Custom time interval
- Static & Dynamic Triggers
- Pre-creates partitions (customizable how many)
- Manage child table properties from parent
  - Indexes, constraints, defaults, privileges & ownership
- Automatically updates trigger functions as needed.
- Handles object name length limit (63 char)
- Constraint exclusion for non-partition columns

Automated Creation

- Python script to partition existing data
- Commits after each partition created or
- Commit in smaller batches with configured wait
- Partition live, production tables
  - Partitioned 74 mil row table by day (30 days of data)
  - Committed in hourly blocks w/ 5 second wait
  - Streaming slave never fell more than 100 seconds behind
  - 2-3 second lock on parent was only interruption

Static Partitioning

- Readable functions!

```
CREATE OR REPLACE FUNCTION partman_test.time_static_table_part_trig_func()
 RETURNS trigger
 LANGUAGE plpgsql
AS $function$
        BEGIN
        IF TG_OP = 'INSERT' THEN
            IF NEW.col3 >= '2013-03-21 00:00:00-04' AND NEW.col3 < '2013-03-22 00:00:00-04' THEN
                INSERT INTO partman_test.time_static_table_p2013_03_21 VALUES (NEW.*);
            ELSIF NEW.col3 >= '2013-03-20 00:00:00-04' AND NEW.col3 < '2013-03-21 00:00:00-04' THEN
                INSERT INTO partman_test.time_static_table_p2013_03_20 VALUES (NEW.*);
            ELSIF NEW.col3 >= '2013-03-22 00:00:00-04' AND NEW.col3 < '2013-03-23 00:00:00-04' THEN
                INSERT INTO partman_test.time_static_table_p2013_03_22 VALUES (NEW.*);
            ELSIF NEW.col3 >= '2013-03-19 00:00:00-04' AND NEW.col3 < '2013-03-20 00:00:00-04' THEN
                INSERT INTO partman_test.time_static_table_p2013_03_19 VALUES (NEW.*);
            ELSIF NEW.col3 >= '2013-03-23 00:00:00-04' AND NEW.col3 < '2013-03-24 00:00:00-04' THEN
                INSERT INTO partman_test.time_static_table_p2013_03_23 VALUES (NEW.*);
            ELSE
                RETURN NEW;
            END IF;
        END IF;
        RETURN NULL;
        END $function$
```

Dynamic Partitioning

```
CREATE OR REPLACE FUNCTION partman_test.time_dynamic_table_part_trig_func()
 RETURNS trigger
 LANGUAGE plpgsql
AS $function$
        DECLARE
            v_count                 int;
            v_partition_name        text;
            v_partition_timestamp   timestamptz;
            v_schemaname            text;
            v_tablename             text;
        BEGIN
        IF TG_OP = 'INSERT' THEN
            v_partition_timestamp := date_trunc('day', NEW.col3);
            v_partition_name := 'partman_test.time_dynamic_table_p'|| to_char(v_partition_timestamp, 'YYYY_MM_DD');
            v_schemaname := split_part(v_partition_name, '.', 1);
            v_tablename := split_part(v_partition_name, '.', 2);
            SELECT count(*) INTO v_count FROM pg_tables WHERE schemaname = v_schemaname AND tablename
= v_tablename;
            IF v_count > 0 THEN
                EXECUTE 'INSERT INTO '||v_partition_name||' VALUES($1.*)' USING NEW;
            ELSE
                RETURN NEW;
            END IF;
        END IF;

        RETURN NULL;
        END $function$
```

MAGIC

Automated Destruction

- Configurable retention policy
  - Time: Drop tables with values older than 3 months
  - Serial: Drop tables with values less than 1000 minus current max
- By default only uninherits
- Can drop old tables or only their indexes
- Dump out tables for archiving
- Python script to undo partitioning

PgTAP

- Unit testing for PostgreSQL queries, schema & scripting
- Essential for extension development
- … and your sanity
- http://pgtap.org/

Links

- https://github.com/omniti-labs/pg_extractor
- https://github.com/omniti-labs/pg_jobmon
- https://github.com/omniti-labs/mimeo
- https://github.com/keithf4/pg_partman

Bonus!

- pg_bloat_check.py
- Stol... borrowed query from check_postgres.pl
- Provide easily readable report on current status of table & index bloat