PALOMINO | OPERATIONAL EXCELLENCE FOR DATABASES

PostgreSQL FTS

PGBR 2013

by Emanuel Calvo

Palomino - Service Offerings

- Monthly Support:
  - Being renamed to Palomino DBA as a service.
  - Eliminating 10 hour monthly clients.
  - Discounts are based on spend per month (0-80, 81-160, 161+
  - We will be penalizing excessive paging financially.
  - Quarterly onsite day from Palomino executive, DBA and PM for clients using 80 hours or more per month.
  - Clients using 80-160 hours get 2 New Relic licenses. 160 hours plus get 4.
- Adding annual support contracts:
  - Consultation as needed.
  - Emergency pages allowed.
  - Small bucket of DBA hours (8, 16 or 24)

For more information, please go to: Spreadsheet

“Advanced Technology Partner” for Amazon Web Services

About me:

- Operational DBA at PalominoDB.
  - MySQL, Maria and PostgreSQL databases (and others)
- Community member

- Check out my LinkedIn Profile at: http://es.linkedin.com/in/ecbcbcb/

Credits

- Thanks to:
  - Andrew Atanasoff
  - Vlad Fedorkov
  - All the PalominoDB people that help out !

Agenda

- What we are looking for?
- Concepts
- Native Postgres Support
  - http://www.postgresql.org/docs/9.2/static/textsearch.html
- External solutions
  - Sphinx
    - http://sphinxsearch.com/
  - Solr
    - http://lucene.apache.org/solr/

What are we looking for?

- Finish the talk knowing what FTS is for.
- Have an idea which are our tools.
- Which of those tools are the best fit.

Goals of FTS

- Add complex searches using synonyms, specific operators or spellings.
  - Improving performance sacrificing accuracy.
- Reduce IO and CPU utilization.
  - Text consumes a lot of IO for read and CPU for operations.
- FTS can be handled:
  - Externally
    - using tools like Sphinx or Solr
    - Ideal for massive text search, simple queries
  - Internally
    - native FTS support.
    - Ideal for complex queries combining with other business rules
- Order words by relevance
- Language sensitive
- Faster than regular expressions or LIKE operands

The future of native FTS

- https://wiki.postgresql.org/wiki/PGCon2013_Unconference_Future_of_Full-Text_Search
- http://wiki.postgresql.org/images/2/25/Full-text_search_in_PostgreSQL_in_milliseconds-extended-version.pdf

- 150 Kb patch for 9.3
- GIN/GIST interface improved

WHY FTS??

You may be asking this now.

... and the answer is this reaction when I see a “LIKE ‘%pattern%’”

Concepts

- Parsers
  - 23 token types (url, email, file, etc)
- Token
- Stop word
- Lexeme
  - array of lexemes + position + weight = tsvector
- Dictionaries
  - Simple Dictionary
    - The simple dictionary template operates by converting the input token to lower case and checking it against a file of stop words.
  - Synonym Dictionary
  - Thesaurus Dictionary
  - Ispell Dictionary
  - Snowball Dictionary

Limitations

- The length of each lexeme must be less than 2K bytes
- The length of a tsvector (lexemes + positions) must be less than 1 megabyte
- The number of lexemes must be less than 264
- Position values in tsvector must be greater than 0 and no more than **16,383**
- No more than 256 positions per lexeme
- The number of nodes (lexemes + operators) in a tsquery must be less than 32,768
- Those limits are hard to be reached!

*For comparison, the PostgreSQL 8.1 documentation contained **10,441** unique words, a total of 335,420 words, and the most frequent word “postgresql” was mentioned 6,127 times in 655 documents.*
Another example — the PostgreSQL mailing list archives contained 910,989 unique words with 57,491,343 lexemes in 461,020 messages.

Elements

```
\dF[+]  [PATTERN]      list text search configurations
\dFd[+] [PATTERN]      list text search dictionaries
\dFp[+] [PATTERN]      list text search parsers
\dFt[+] [PATTERN]      list text search templates
```

```
full_text_search=# \dFd+ *
                                List of text search dictionaries
  Schema  |      Name       |         Template         |              Init options                     |         Description

------------+-----------------+---------------------+--------------------------------------------------+---------------------------------------------------------
 pg_catalog | danish_stem     | pg_catalog.snowball | language = 'danish', stopwords = 'danish'         | snowball stemmer for danish language
 pg_catalog | dutch_stem      | pg_catalog.snowball | language = 'dutch', stopwords = 'dutch'           | snowball stemmer for dutch language
 pg_catalog | english_stem    | pg_catalog.snowball | language = 'english', stopwords = 'english'       | snowball stemmer for english language
 pg_catalog | finnish_stem    | pg_catalog.snowball | language = 'finnish', stopwords = 'finnish'       | snowball stemmer for finnish language
 pg_catalog | french_stem     | pg_catalog.snowball | language = 'french', stopwords = 'french'         | snowball stemmer for french language
 pg_catalog | german_stem     | pg_catalog.snowball | language = 'german', stopwords = 'german'         | snowball stemmer for german
language
 pg_catalog | hungarian_stem  | pg_catalog.snowball | language = 'hungarian', stopwords = 'hungarian'   | snowball stemmer for hungarian language
 pg_catalog | italian_stem    | pg_catalog.snowball | language = 'italian', stopwords = 'italian'   | snowball stemmer for italian language
 pg_catalog | norwegian_stem  | pg_catalog.snowball | language = 'norwegian', stopwords = 'norwegian'   | snowball stemmer for norwegian language
 pg_catalog | portuguese_stem | pg_catalog.snowball | language = 'portuguese', stopwords = 'portuguese' | snowball stemmer for portuguese language
 pg_catalog | romanian_stem   | pg_catalog.snowball | language = 'romanian'                         | snowball stemmer for romanian language
 pg_catalog | russian_stem    | pg_catalog.snowball | language = 'russian', stopwords = 'russian'       | snowball stemmer for russian language
 pg_catalog | simple          | pg_catalog.simple   |                                               | simple dictionary: just lower case and check for
stopword
 pg_catalog | spanish_stem    | pg_catalog.snowball | language = 'spanish', stopwords = 'spanish'       | snowball stemmer for spanish
language
 pg_catalog | swedish_stem    | pg_catalog.snowball | language = 'swedish', stopwords = 'swedish'       | snowball stemmer for swedish
language
 pg_catalog | turkish_stem    | pg_catalog.snowball | language = 'turkish', stopwords = 'turkish'       | snowball stemmer for turkish language
(16 rows)
```

Elements

```
postgres=# \dF
               List of text search configurations
   Schema   |    Name    |              Description
------------+------------+---------------------------------------
 pg_catalog | danish     | configuration for danish language
 pg_catalog | dutch      | configuration for dutch language
 pg_catalog | english    | configuration for english language
 pg_catalog | finnish    | configuration for finnish language
 pg_catalog | french     | configuration for french language
 pg_catalog | german     | configuration for german language
 pg_catalog | hungarian  | configuration for hungarian language
 pg_catalog | italian    | configuration for italian language
 pg_catalog | norwegian  | configuration for norwegian language
 pg_catalog | portuguese | configuration for portuguese language
 pg_catalog | romanian   | configuration for romanian language
 pg_catalog | russian    | configuration for russian language
 pg_catalog | simple     | simple configuration
 pg_catalog | spanish    | configuration for spanish language
 pg_catalog | swedish    | configuration for swedish language
 pg_catalog | turkish    | configuration for turkish language
(16 rows)
```

Elements

```
                        List of data types
  Schema   |   Name    |                    Description
------------+-----------+---------------------------------------------------------
 pg_catalog | gtsvector | GiST index internal text representation for text search
 pg_catalog | tsquery   | query representation for text search
 pg_catalog | tsvector  | text representation for text search
(3 rows)
```

Some operators:

- @@ (tsvector against tsquery)
- || concatenate tsvectors (it reorganises lexemes and ranking)

Small Example

```
full_text_search=# create table basic_example (i serial PRIMARY KEY, whole text, fulled tsvector, dictionary
regconfig);
postgres=# CREATE TRIGGER tsvectorupdate BEFORE INSERT OR UPDATE
ON basic_example FOR EACH ROW EXECUTE PROCEDURE tsvector_update_trigger(fulled,
"pg_catalog.english", whole);
CREATE TRIGGER
postgres=# insert into basic_example(whole,dictionary) values ('This is an example','english'::regconfig);
INSERT 0 1
full_text_search=# create index on basic_example(to_tsvector(dictionary,whole));
CREATE INDEX
full_text_search=# create index on basic_example using GIST(to_tsvector(dictionary,whole));
CREATE INDEX

postgres=# select * from basic_example;
 i |       whole        |   fulled    | dictionary
---+--------------------+-------------+------------
 5 | This is an example | 'exampl':4 | english
(1 row)
```

Pre processing

- Documents into tokens
    - Find and clean
- Tokens into lexemes
    - Token normalised to a language or dictionary
    - Eliminate stop words (high frequently words)
- Storing
    - Array of lexemes (tsvector)
        - the position of the word respect the presence of stop words, although they are not stored
        - Stores positional information for proximity info

Highlighting

- ts_headline
  - it doesn't use tsvector and needs to use the entire document, so could be expensive.
- Only for certain type of queries or titles

```
postgres=# SELECT ts_headline('english','Just a simple example of a highlighted query and
similarity.',to_tsquery('query & similarity'),'StartSel = <, StopSel = >');
                              ts_headline
--------------------------------------------------------------
 Just a simple example of a highlighted <query> and <similarity>.
(1 row)
```

Default:
StartSel=, StopSel=,
MaxWords=35, MinWords=15, ShortWord=3, HighlightAll=FALSE,
MaxFragments=0, FragmentDelimiter=" ... "

Ranking

- Weights: (A B C D)
- Ranking functions:
  - ts_rank
  - ts_rank_cd
- Ranking is expensive cause re process and check each tsvector.

```
SELECT to_tsquery('english', 'Fat | Rats:AB');
to_tsquery
-------------------
'fat' | 'rat':AB
```

Also, * can be attached to a lexeme to specify prefix matching:

```
SELECT to_tsquery('supern:*A & star:A*B');
to_tsquery
---------------------------
'supern':*A & 'star':*AB
```

Maniputaling tsvectors and tsquery

- Manipulating tsvectors
  - setweight(vector tsvector, weight "char") returns tsvector
  - lenght (tsvector) : number of lexemes
  - strip (tsvector): returns tsvector without additional position as weight or position

- Manipulating Queries
- If you need a dynamic input for a query, parse it with *numnode(tsquery*), it will avoid unnecessary searches if contains a lot of stop words
  - numnode(plainto_tsquery('a the is'))
  - clean the queries using querytree also, is useful

Example

```
postgres=# select * from ts_debug('english','The doctor saids I''m sick.');
   alias   |   description   | token  |  dictionaries  |  dictionary  | lexemes
-----------+-----------------+--------+----------------+--------------+----------
 asciiword | Word, all ASCII | The    | {english_stem} | english_stem | {}
 blank     | Space symbols   |        | {}             |              |
 asciiword | Word, all ASCII | doctor | {english_stem} | english_stem | {doctor}
 blank     | Space symbols   |        | {}             |              |
 asciiword | Word, all ASCII | saids  | {english_stem} | english_stem | {said}
 blank     | Space symbols   |        | {}             |              |
 asciiword | Word, all ASCII | I      | {english_stem} | english_stem | {}
 blank     | Space symbols   | '      | {}             |              |
 asciiword | Word, all ASCII | m      | {english_stem} | english_stem | {m}
 blank     | Space symbols   |        | {}             |              |
 asciiword | Word, all ASCII | sick   | {english_stem} | english_stem | {sick}
 blank     | Space symbols   | .      | {}             |              |
(12 rows)
```

```
postgres=# select numnode(plainto_tsquery('The doctor saids I''m sick.')), plainto_tsquery('The doctor saids I''m sick.'),
to_tsvector('english','The doctor saids I''m sick.'), ts_lexize('english_stem','The doctor saids I''m sick.');
 numnode |             plainto_tsquery              |              to_tsvector               |            ts_lexize
---------+------------------------------------------+----------------------------------------+-------------------------------
       7 | 'doctor' & 'said' & 'm' & 'sick' | 'doctor':2 'm':5 'said':3 'sick':6 | {"the doctor saids i'm sick."}
(1 row)
```

Maniputaling tsquery

```
postgres=# SELECT querytree(to_tsquery('!defined'));
 querytree
-----------
 T
(1 row)

postgres=# SELECT querytree(to_tsquery('cat & food | (dog & run & food)'));
                  querytree
-----------------------------------------
 'cat' & 'food' | 'dog' & 'run' & 'food'
(1 row)

postgres=# SELECT querytree(to_tsquery('the '));
NOTICE:  text-search query contains only stop words or doesn't contain lexemes, ignored
 querytree
-----------

(1 row)
```

Automating updates on tsvector

- Postgresql provide standard functions for this:
  - tsvector_update_trigger(tsvector_column_name, config_name, text_column_name [, ...])
  - tsvector_update_trigger_column(tsvector_column_name, config_column_name, text_column_name [, ...

```
CREATE TABLE messages (
title text,
body text,
tsv tsvector
);
CREATE TRIGGER tsvectorupdate BEFORE INSERT OR UPDATE
ON messages FOR EACH ROW EXECUTE PROCEDURE
tsvector_update_trigger(tsv, ’pg_catalog.english’, title, body);
```

Automating updates on tsvector (2)

If you want to keep a custom weight:

```
CREATE FUNCTION messages_trigger() RETURNS trigger AS $$
    begin
    new.tsv :=
    setweight(to_tsvector(’pg_catalog.english’, coalesce(new.title,”)), ’A’) ||
    setweight(to_tsvector(’pg_catalog.english’, coalesce(new.body,”)), ’D’);
    return new;
end
$$ LANGUAGE plpgsql;

CREATE TRIGGER tsvectorupdate BEFORE INSERT OR UPDATE
ON messages FOR EACH ROW EXECUTE PROCEDURE messages_trigger();
```

Tips and considerations

- Store the text externally, index on the database
  - requires superuser
- Store the whole document on the database, index on Sphinx/Solr
- Don't index everything
  - Solr /Sphinx are not databases, just index only what you want to search. Smaller indexes are faster and easy to maintain.
- ts_stats
  - can help you out to check your FTS configuration
- You can parse URLS, mails and whatever using ts_debug function for nun intensive operations

Tips and considerations

- You can index by language

```
CREATE INDEX pgweb_idx_en ON pgweb USING gin(to_tsvector('english', body)) WHERE config_language = 'english';
CREATE INDEX pgweb_idx_fr ON pgweb USING gin(to_tsvector('french', body)) WHERE config_language = 'french';
CREATE INDEX pgweb_idx ON pgweb USING gin(to_tsvector(config_language, body));
CREATE INDEX pgweb_idx ON pgweb USING gin(to_tsvector('english', title || ' ' || body));
```

- Table partition using language is also a good practice

Features on 9.2

- Move tsvector most-common-element statistics to new [pg_stats] columns (Alexander Korotkov)
- Consult most_common_elems and most_common_elem_freqs for the data formerly available in most_common_vals and most_common_freqs for a tsvector column.

most_common_elems | {exampl}
most_common_elem_freqs | {1,1,1}

Links

- http://www.postgresql.org/docs/9.2/static/textsearch.htm
- http://www.postgresql.org/docs/9.2/static/textsearch-migration.html > migration from version pre-8.3

Sphinx

Sphinx

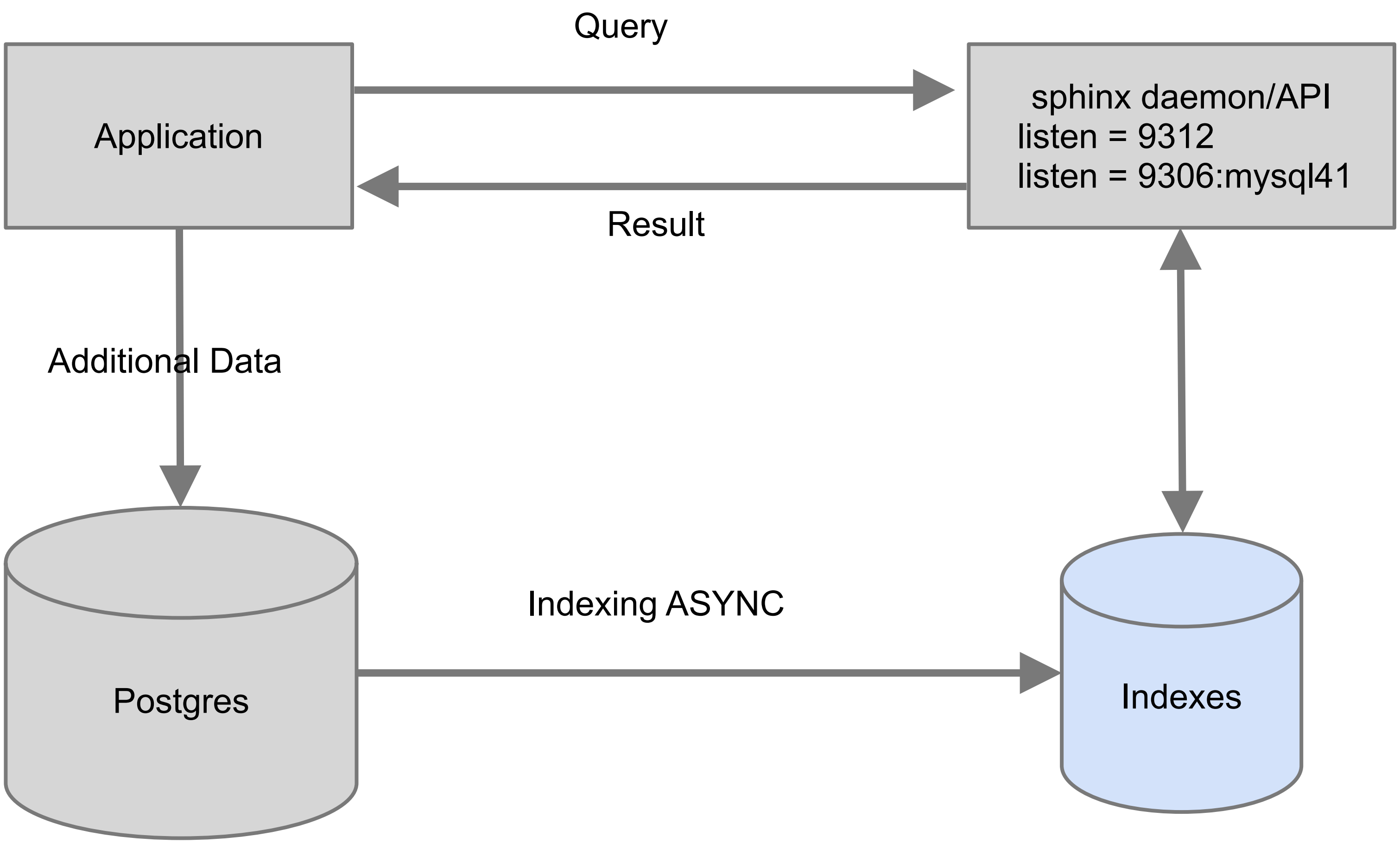
- Standalone daemon written on C++
- Highly scalable
  - Known installation consists 50+ Boxes, 20+ Billions of documents
- Extended search for text and non-full-text data
  - Optimized for faceted search
  - Snippets generation based on language settings
- Very fast
  - Keeps attributes in memory
    - See Percona benchmarks for details
- Receiving data from PostgreSQL
  - Dedicated PostgreSQL datasource type.

http://sphinxsearch.com

Key features- Sphinx

- Scalability & failover
- Extended FT language
  - Faceted search support
  - GEO-search support
- Integration and pluggable architecture
  - Dedicated PostgreSQL source, UDF support
- Morphology & stemming
- Both batch & real-time indexing is available
- Parallel snippets generation

Sphinx - Basic 1 host architecture



What's new on Sphinx

- 1. added AOT (new morphology library, lemmatizer) support
  - Russian only for now; English coming soon; small 10-20% indexing impact; it's all about search quality (much much better "stemming")
- 2. added JSON support
  - limited support (limited subset of JSON) for now; JSON sits in a column; you're able to do thing like WHERE jsoncol.key=123 or ORDER BY or GROUP BY
- 3. added subselect syntax that reorders result sets, SELECT * FROM (SELECT ... ORDER BY cond1 LIMIT X) ORDER BY cond2 LIMIT Y
- 4. added bigram indexing, and quicker phrase searching with bigrams (bigram_index, bigram_freq_words directives)
  - improves the worst cases for social mining
- 5. added HA support, ha_strategy, agent_mirror directives
- 6. added a few new geofunctions (POLY2D, GEOPOLY2D, CONTAINS)
- 7. added GROUP_CONCAT()
- 8. added OPTIMIZE INDEX rtindex, rt_merge_iops, rt_merge_maxiosize directives
- 9. added TRUNCATE RTINDEX statement

Sphinx - Postgres compilation

[root@ip-10-55-83-238 ~]# yum install gcc-c++.noarch
[root@ip-10-55-83-238 sphinx-2.0.6-release]# ./configure --prefix=/opt/sphinx --without-mysql --with-pgsql-includes=$PGSQL_INCLUDE --with-pgsql-libs=$PGSQL_LIBS --with-pgsql
[root@ip-10-55-83-238 sphinx]# /opt/pg/bin/psql -Upostgres -hmaster test < etc/example-pg.sql

* Package is compiled with mysql libraries dependencies

Data source flow (from DBs)

- Connection to the database is established
- Pre-query, is executed to perform any necessary initial setup, such as setting per-connection encoding with MySQL;
- main query is executed and the rows it returns are indexed;
- Post-query is executed to perform any necessary cleanup;
- connection to the database is closed;

- indexer does the sorting phase (to be pedantic, index-type specific post-processing);
- connection to the database is established again;
- post-index query, is executed to perform any necessary final cleanup;
- connection to the database is closed again.

Sphinx - Daemon

- For speed
  - to offload main database
  - to make particular queries faster
    - Actually most of search-related
- For failover
  - It happens to best of us!
- For extended functionality
  - Morphology & stemming
  - Autocomplete, “do you mean” and “Similar items”

SOLR/Lucene

Solr Features

- Advanced Full-Text Search Capabilities
- Optimized for High Volume Web Traffic
- Standards Based Open Interfaces - XML, JSON and HTTP
- Comprehensive HTML Administration Interfaces
- Server statistics exposed over JMX for monitoring
- Linearly scalable, auto index replication, auto failover and recovery
- Near Real-time indexing
- Flexible and Adaptable with XML configuration
- Extensible Plugin Architecture

Solr

- http://lucene.apache.org/solr/features.html
- Solr uses Lucene Library

Thanks!

Contact us!

We are hiring!

emanuel@palominodb.com