Port databases from MySQL to PostgreSQL

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Was ist PostgreSQL?

- Relational Database, released under the PostgreSQL License (similar to BSD-License)
- Worldwide active community
- Numerous features and functions (Foreign Keys, Transactions, Triggers, ...)
- Runs on many Operating Systems
- New releases every year, support for 5 years/releases (whichever is longer)
- Version 9.2 is in development

PostgreSQL– The correct name

- "PostgreSQL " is the product name
- "Postgres" is a widely accepted alias
- "PG" and "PGSQL" are recognized
- "Postgre" is just plain wrong

Andreas Scherbaum

- Work with databases since 1997, with PostgreSQL since 1998
- Founding Member of the European and the German PostgreSQL User Group
- Board of Directors – European PostgreSQL User Group
- Regional Contact PostgreSQL for Germany
- Ran my own company for 7+ years – around PostgreSQL
- Since 2011 with EMC^2/Greenplum, Data Computing Division

What does this queer `.la` mean?

`http://andreas.scherbaum.la/`

- `.la` is the TLD of Laos
- `.la` is used and managed by Los Angeles
- `LA` is also the plate number for Landshut (Lower Bavaria, Germany)
- I lived there for a long time, my wife liked the domain (and I bought several more TLDs)

TOC

- History MySQL
- Gotchas when porting
- Tools

The (recent) history of MySQL MySQL

- 1994: started with version number 3.21
- quickly gained importance on the Web, together with PHP (LAMP)
- **October 2005**: Oracle acquires InnoDB (Storage Engine for MySQL)
- **February 2006**: Oracle acquires Sleepycat (another Storage Engine for MySQL)
- **2006**: attempted takeover by Oracle, background unclear
- **February 2008**: acquired by Microsystems
- **April 2009**: Oracle acquires Sun Microsystems
- among others: Java, MySQL, OpenSolaris, OpenOffice, GlassFish
- **November 2010**: Confusion in the press about price increases

Confusion among users

- No clear statement on the future of MySQL by Oracle
- Confusion about price increases
- Problems in other projects undertaken by Oracle (OpenSolaris, OpenOffice, Hudson, ...)
- Forks with a variety of different positionings
- Various storage engines with different functionality

Alternatives for users

- Changing to a different database

Starting points

- Frameworks (eg Hibernate) simplify the work
- Analysis of the application(s), update the documentation
- Porting the database
- Porting the application(s)

AUTO_INCREMENT

- AUTO_INCREMENT increases at every INSERT

Example (AUTO_INCREMENT)

```
CREATE TABLE ... (
  id     INTEGER     PRIMARY KEY
                     AUTO_INCREMENT,
  ...
);
```

AUTO_INCREMENT Replacement: SERIAL

- Sequences (SERIAL) in PostgreSQL provide the same functionality ... and more

Example (SERIAL)

```
CREATE TABLE ... (
  id     SERIAL      PRIMARY KEY,
  ...
);
```

- Sequences can count up and down
- ... can count in wider steps
- ... can be used for more than one table
- ... can be independant of a table

TIMESTAMP

- The first TIMESTAMP column in a table is set automatically by MySQL

Example (TIMESTAMP)

```
CREATE TABLE ... (
  changed_at     TIMESTAMP,
  ...
);
```

- Disadvantage: this "feature" cannot be deactivated

TIMESTAMP Replacement: Trigger

- A trigger sets the current value in a reliable way

Example (Trigger)

```
CREATE TABLE ... (
  changed_at     TIMESTAMPTZ,
  ...
);

CREATE TRIGGER trigger_timestamp
       BEFORE INSERT OR UPDATE ON ...
       FOR EACH ROW EXECUTE PROCEDURE trigger_settime();
```

- PostgreSQL Advantage: needs no second column

TIMESTAMP Replacement: Trigger

Example (Trigger)

```
CREATE FUNCTION trigger_settime ()
       RETURNS TRIGGER AS $$
BEGIN

  IF TG_OP = 'INSERT' THEN
      NEW.insert_at := NOW();
      NEW.changed_at := NOW();
  END IF;
  IF TG_OP = 'UPDATE' THEN
      NEW.insert_at := OLD.insert_at;
      NEW.changed_at := NOW();
  END IF;

  RETURN NEW;
END
$$ LANGUAGE plpgsql;
```

CHECK Clause

- MySQL accepts but ignores CHECK clauses

Example (TIMESTAMP)

```
CREATE TABLE ... (
  password     CHAR(32)
               CHECK (LENGTH(password) = 32),
  ...
);
```


CHECK-Klausel

- PostgreSQL accepts CHECK clauses and enforces them
- Disadvantage: Now you have to write CHECK clauses ;-)

DEFAULT Values

- DEFAULT values are handled similar
- Special treatment for TIMESTAMP columns
- MySQL generates a DEFAULT value for NOT NULL columns:
- 0 for numbers and integers
- "" (empty string) for text
- first value for ENUMs
- in PostgreSQL, DEFAULT are to set explicitly
- a INSERT without value will result in an error

ZEROFILL

- MySQL knows ZEROFILL to fill columns with 0 at the beginning

Example (ZEROFILL)

```
CREATE TABLE ... (
  number       INTEGER ZEROFILL,
  ...
);
```

Example (ZEROFILL)

```
+------------+
| number     |
+------------+
| 0000000001 |
+------------+
```

ZEROFILL Replacement: suitable formatted output

- in PostgreSQL the number format is part of the output function

Example (ZEROFILL)

```
test=# SELECT lpad(1::TEXT, 10, '0');
    lpad
------------
 0000000001
(1 row)
```


GROUP BY

- MySQL allows GROUP BY with single columns

Example (GROUP BY)

```
CREATE TABLE groupby_test (
  id          INTEGER      PRIMARY KEY,
  data        VARCHAR(10)  NOT NULL
);

INSERT INTO groupby_test (id, data) VALUES (1, 'Car');
INSERT INTO groupby_test (id, data) VALUES (2, 'Ship');
INSERT INTO groupby_test (id, data) VALUES (3, 'Aircraft');
INSERT INTO groupby_test (id, data) VALUES (4, 'Car');
INSERT INTO groupby_test (id, data) VALUES (5, 'Ship');
```

GROUP BY

Example (GROUP BY)

```
mysql> SELECT id, data FROM groupby_test GROUP BY data;
+----+----------+
| id | data     |
+----+----------+
|  1 | Car      |
|  2 | Ship     |
|  3 | Aircraft |
+----+----------+
3 rows in set (0.00 sec)
```

- We remember: `Car` had the IDs `1` **and** `4` ...

GROUP BY Replacement: Write correct queries

- PostgreSQL requires:
- All columns must appear in `GROUP BY`
- Or must be used in an aggregate function

Example (GROUP BY)

```
test=# SELECT id, data FROM groupby_test GROUP BY data;
ERROR:  column "groupby_test.id" must appear in the GROUP BY
        clause or be used in an aggregate function
LINE 1: SELECT id, data FROM groupby_test GROUP BY data;
```

GROUP BY Replacement: Write correct queries

Example (GROUP BY)

```
test=# SELECT MIN(id), data FROM groupby_test GROUP BY data;
 min |  data
-----+----------
   2 | Ship
   1 | Car
   3 | Aircraft
(3 rows)
```

- Advantage: unambiguous results

Sort and NULL Values

- MySQL sorts NULL values first
- PostgreSQL at the end

Example (NULL)

```
CREATE TABLE null_test (
  id       INTEGER          PRIMARY KEY,
  data     VARCHAR(10)
);

INSERT INTO null_test (id, data) VALUES (1, 'a');
INSERT INTO null_test (id, data) VALUES (2, NULL);
INSERT INTO null_test (id, data) VALUES (3, 'b');
INSERT INTO null_test (id, data) VALUES (4, NULL);
INSERT INTO null_test (id, data) VALUES (5, 'c');
```

Sort and NULL Values

Example (NULL: in MySQL)

```
mysql> SELECT id, data FROM null_test ORDER BY data;
+----+-------+
| id | data  |
+----+-------+
|  2 | NULL  |
|  4 | NULL  |
|  1 | a     |
|  3 | b     |
|  5 | c     |
+----+-------+
5 rows in set (0.06 sec)
```


Sort and NULL Values

Example (NULL: in PostgreSQL)

```
test=# SELECT id, data FROM null_test ORDER BY data;
 id | data
----+-------
  1 | a
  3 | b
  5 | c
  2 |
  4 |
(5 rows)
```

Sort and NULL Values: NULLS FIRST

Example (NULL: NULLS FIRST)

```
test=# SELECT id, data FROM null_test ORDER BY data NULLS FIRST;
 id | data
----+-------
  2 |
  4 |
  1 | a
  3 | b
  5 | c
(5 rows)
```


IFNULL()

- MySQL knows IFNULL() and COALESCE()
- However, do not differ significantly

Example (IFNULL())

```
mysql> SELECT IFNULL(NULL, 10);
+------------------+
| IFNULL(NULL, 10) |
+------------------+
|               10 |
+------------------+
1 row in set (0.00 sec)
```

COALESCE()

Example (COALESCE())

```
mysql> SELECT COALESCE(NULL, 10, 20);
+------------------------+
| COALESCE(NULL, 10, 20) |
+------------------------+
|                     10 |
+------------------------+
1 row in set (0.00 sec)
```


IFNULL() Replacement: COALESCE()

- Replace every IFNULL() with COALESCE()
- Difference:
- IFNULL() knows only two parameters
- COALESCE() can handle more parameters

Upper-/Lowercase of identifiers

- In MySQL (depends on the table type) the file system specifies the upper/lowercase handling of identifiers
- On Windows there is no difference between upper and lowercase names
- On some Unix Systems the upper and lowercase makes a difference
- In PostgreSQL the filesystem doesn't matter ;-)

Upper-/Lowercase of identifiers

- In MySQL there is a config parameter: `lower_case_table_names`
- 0: case-sensitive (do not use on Windows or Mac OS X!)
- 1: Table names are lowercase, and also compared lowercase
- 2: Table names are written as specified, but compared lowercase

Upper-/Lowercase of identifiers

- The SQL standard requires all identifiers to be uppercase
- PostgreSQL makes all identifiers lowercase

Example (Upper-/Lowercase)

```
test# SELECT 1 AS BIG;
 big
-----
   1
(1 row)
```

Example (Upper-/Lowercase)

```
test# SELECT 1 AS MiXeD;
 mixed
-------
     1
(1 row)
```


Upper-/Lowercase of identifiers

- If you want to write the identifier in uppercase, you have to use ""

Example (Upper-/Lowercase)

```
test# SELECT 1 AS "MiXeD";
 MiXeD
-------
     1
(1 row)
```

- Pay attention is you use frameworks!

CONSTRAINTs and REFERENCES

- Some MySQL table types know CONSTRAINTs and REFERENCES
- Others not
- Result: they are rarely used (data integrity, anyone?)

- Further characteristics:
- Both columns must have the same definitionn (same data type, NULL/NOT NULL)
- Both columns must have an index

Date and Time Values

- Data types for Date and Time values differ greatly

- Output format functions vary
- TIMESTAMP in PostgreSQL uses a microsecond resolution
- in addition: TIMESTAMPTZ includes a time zone
- Operations involving time values return a type INTERVAL in PostgreSQL

- Conclusion: much manual work is needed :-(

Date and Time Values

- Example: `year()`, `month()` and `day()`

Example (Date functions)

```
test=# SELECT to_char(NOW(), 'YYYY') AS year,
              to_char(NOW(), 'MM') AS month,
              to_char(NOW(), 'DD') AS day;
 year | month | day
------+-------+-----
 2011 | 10    | 03
(1 row)
```


ORDER BY RAND()

- Function to generate random numbers
- in MySQL: `RAND()`
- in PostgreSQL: `RANDOM()`

- Search and Replace should be sufficient

LIKE and ILIKE

- LIKE in MySQL does not distinguish between upper and lower case
- LIKE in PostgreSQL is case sensitive
- for case insensitive searches: ILIKE

LIKE and ILIKE

Example (LIKE)

```
test# SELECT 'SHIP' LIKE 'ship';
 ?column?
----------
 f
(1 row)
```

Example (ILIKE)

```
test# SELECT 'SHIP' ILIKE 'ship';
 ?column?
----------
 t
(1 row)
```

Boolean Values

- MySQL has no (real) boolean value
- A `SMALLINT(1)` is used to emulate a boolean
- it might happen that your boolean actually contains a 7 as a value
- PostgreSQL knows a real `BOOLEAN` data type

String concentration versus logical operators

- MySQL uses the `||` operator for "logical OR"
- The SQL standard specifies – and PostgreSQL uses – the `||` for text concentration
- You will have fun
- "logic OR" in PostgreSQL is the `OR` operator

String concentration versus logical operators

- MySQL also knows && for "logic AND"
- Fortunately this has no meaning in other databases
- More easy to spot

Binary Data

- MySQL uses `VARBINARY` or `BINARY`
- PostgreSQL uses `BYTEA`

INSERT IGNORE and REPLACE

- MySQL allows skipping of unique key violations by using INSERT IGNORE
- PostgreSQL does not allow that

- REPLACE replaces the line with the same primary key with the new data
- Virtually a INSERT OR UPDATE
- Disadvantage: not in the SQL standard

INSERT IGNORE and REPLACE Replacement

- Replacement for INSERT IGNORE
- the PostgreSQL online documentation contains an example
- Catchword: UPSERT

- Replacement for REPLACE: MERGE
- Several attempts to implement it in PostgreSQL, so far we don't have it

Load data from files

- MySQL uses the `LOAD DATA` syntax
- PostgreSQL uses `COPY`
- Usage is similar

Write data into files

- MySQL uses the `SELECT ... INTO OUTFILE` syntax
- PostgreSQL again uses `COPY`

Comments

- MySQL recognizes as a comment:
- the hash: #
- double hyphen: --
- for multiline comments: /* ... */

- PostgreSQL does not recognize the hash (#) as a comment

Quotes

- MySQL allows to use single and double quotes for data and for identifiers
- PostgreSQL requires single quotes for data (SQL standard)
- PostgreSQL requires double quotes for identifier (SQL standard)

- MySQL allows backticks for the identifier
- Export using the "ansi": option of `mysqldump` is a good start

Example (mysqldump)

```
mysqldump --compatible=ansi
```

Storage Engines

- MySQL knows a great deal of different storage engines, pick some:
- MyISAM, Innodb, Memory, Archive, CSV, PBXT, Solid, Falcon, NDB, GEMINI, BerkeleyDB, Blackhole, Federated, Merge, IBMDB2I, Maria, ScaleDB, XtraDB, Calpont, InfoBright, Kickfire, TokuDB, HEAP, Example, Isam, Q4M, OQGraph, FederatedX, Spider, Sphinx, AWSS3

- Problem: each storage engine offers different advantages and disadvantages
- Implementation details (full text search, transactions, foreign keys, check constraints, upper / lowercase, ...) are dependent upon the engine
- Enjoy selecting the appropriate type :-(

Storage Engines in PostgreSQL

- PostgreSQL does not know different storage engines ;-)
- every table has all features

- All `ENGINE` or `TYPE` parameters must be removed

Transactions

- MySQL knows transactions – in some storage engines
- PostgreSQL uses transactions everywhere
- Use it!

Data Types

- The data types are different, sometimes very greatly

Data Type	Replacement
TINYINT	SMALLINT
SMALLINT	SMALLINT
MEDIUMINT	INTEGER
INT	INTEGER
BIGINT	BIGINT
INT(1)	BOOLEAN or SMALLINT
INT(4)	INTEGER
INT(11)	BIGINT
FLOAT	FLOAT
DOUBLE	DOUBLE PRECISION
REAL	DOUBLE PRECISION
FLOAT(4,7)	FLOAT
NUMERIC	NUMERIC
DECIMAL	DECIMAL

Data Types

Data Type	Replacement
CHAR	CHAR
VARCHAR	VARCHAR
BINARY	BYTEA or TEXT
VARBINARY	BYTEA or TEXT
BLOB	TEXT
TEXT	TEXT
LONG	TEXT
ENUM	ENUM or 1:n table
SET	no replacement, 1:n table possible

Data Types

Data Type	Replacement
DATETIME	TIMESTAMP or TIMESTAMPTZ
DATE	DATE
TIMESTAMP	TIMESTAMP or TIMESTAMPTZ
TIME	TIME
YEAR	DATE

Data Types	Replacement
BIT	BIT or BIT VARYING

Multiple Indexes

- PostgreSQL can use multiple indexes per request

mysql2pgsql

- `mysql2pgsql` can port a database dump
- Works pretty well, but some manual work is still needed
- Import takes longer because `INSERT`s are used instead of `COPY`

Website: `http://pgfoundry.org/projects/mysql2pgsql/`

mysql2pgsql

Example (mysql2pgsql)

```
perl mysql2pgsql.perl mysql-dump.sql pg-dump.sql
```


mysql2pgsql – Useful options

- `--debug` enables debugging
- `--char2varchar` transforms all `CHAR` columns into `VARCHAR` columns
- `--nodrop` removes all `DROP TABLE` statements
- `--schema` defines a schema for the objects
- `--enc_in` character set of the MySQL dump
- `--enc_out` character set for PostgreSQL

Feedback

- Feedback is important for:
- The conference team
- The speaker

Website:
`https://www.postgresql.eu/events/feedback/pgconfde2011/`

Upcoming Event

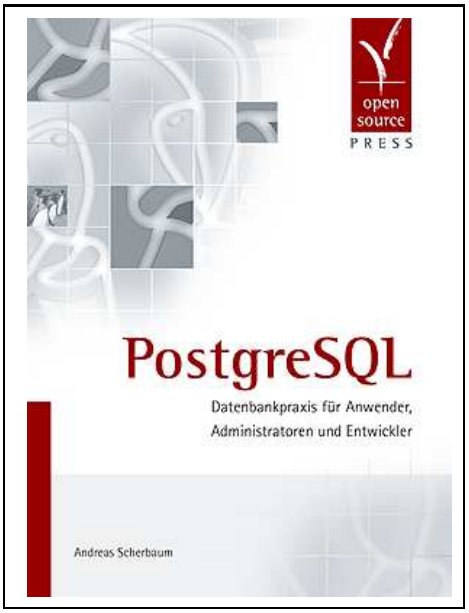
Upcoming Event

`FOSDEM 2012 -- PostgreSQL Devroom (maybe)`

- Februar 4.-5., 2012
- in Brussels

Website: `http://www.fosdem.org/`

PostgreSQL Buch



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