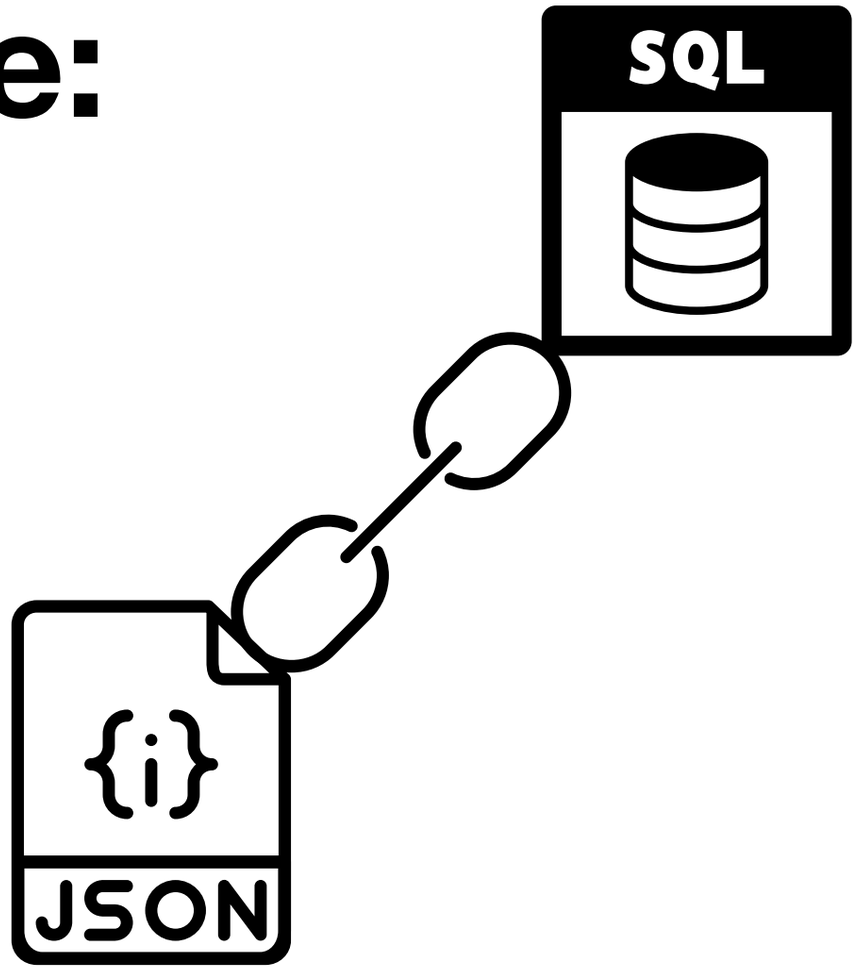
MySQL Document store: SQL and NoSQL united

Giuseppe Maxia

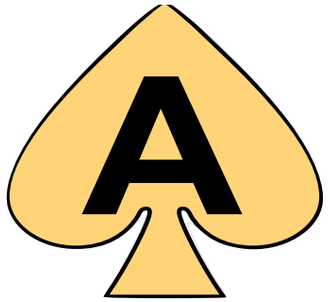
Vmware, Inc



About me

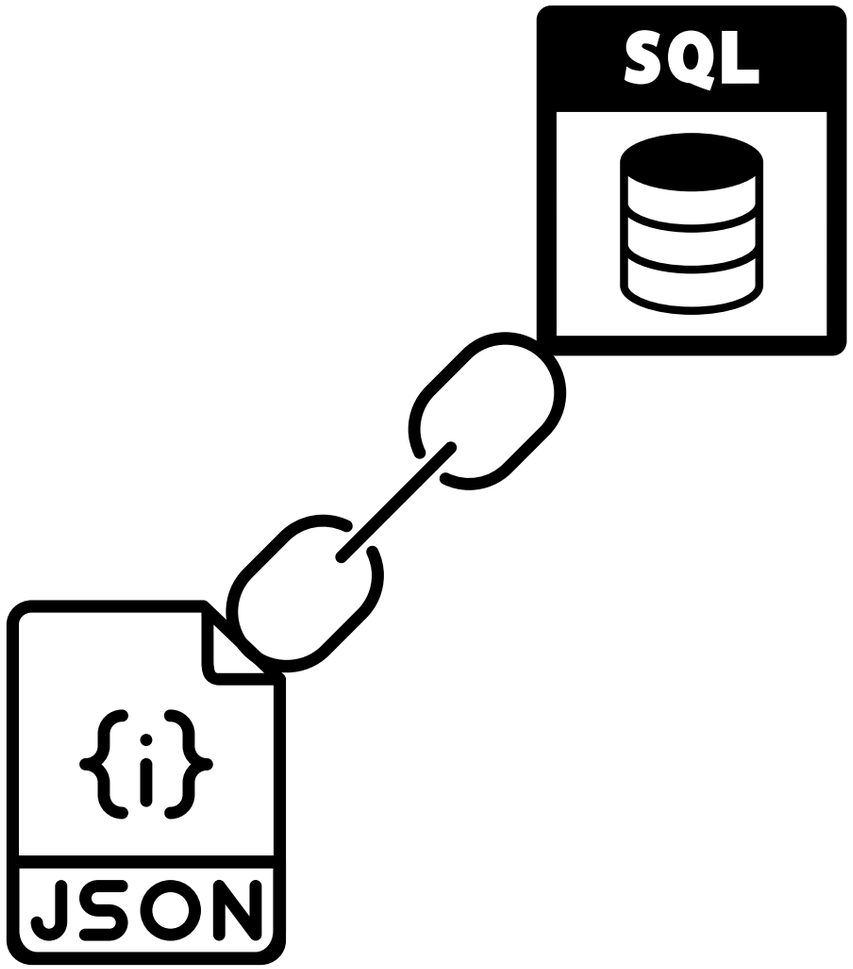
Who's this guy?

- **Giuseppe Maxia, a.k.a. "The Data Charmer"**
- **QA Architect at VMware**
- **25+ years development and DB experience**
- **Long timer MySQL community member.**
- **Oracle ACE Director**
- **Blog: http://datacharmer.blogspot.com**
- **Twitter: @datacharmer**



Agenda

- **Document store in a nutshell**
- **X-Protocol overview**
- **X-Plugin installation**
- **MySQL shell installation**
  - Using Docker
- **Getting started**
- **Example: with the shell**
- **Example: data to and from MongoDB**
- **A look inside**



Disclaimer

Better be clear about this

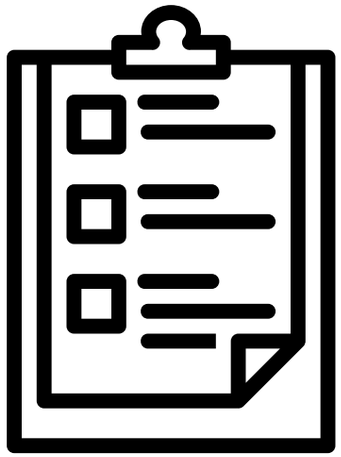
- **This is community work.**

- **Non affiliation:**
  - I don't work for Oracle. All I say here, good or bad, is my opinion.

- **Not talking for my company:**
  - All I say is my own stuff. My company does not influence or censor what I say here.

Requirements

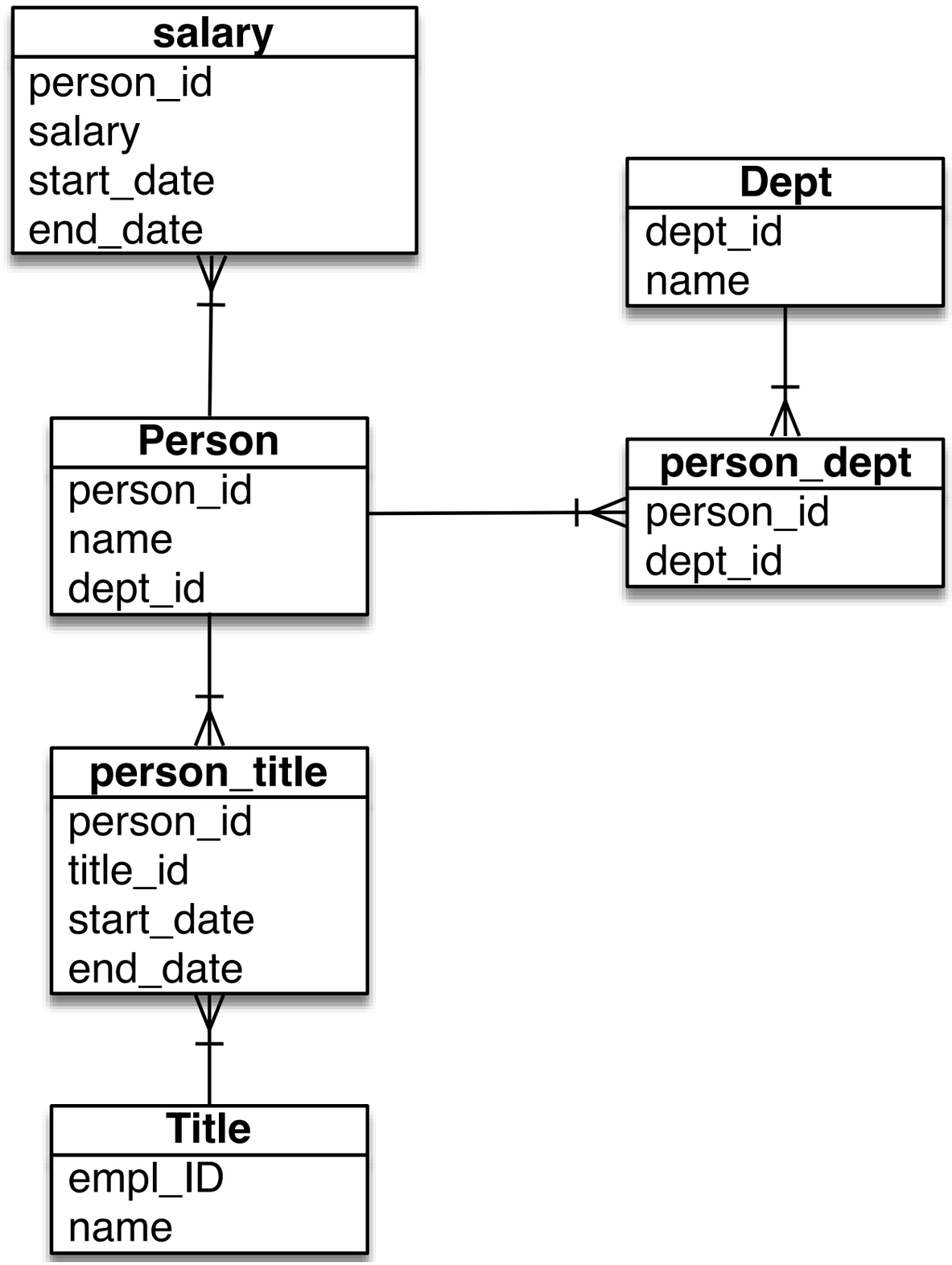
This technology does not work with every version



- **MySQL 5.7.12 or later (contains the X-Plugin)**
- **MySQL shell (separate product)**

How DBAs see data

This is not intuitive



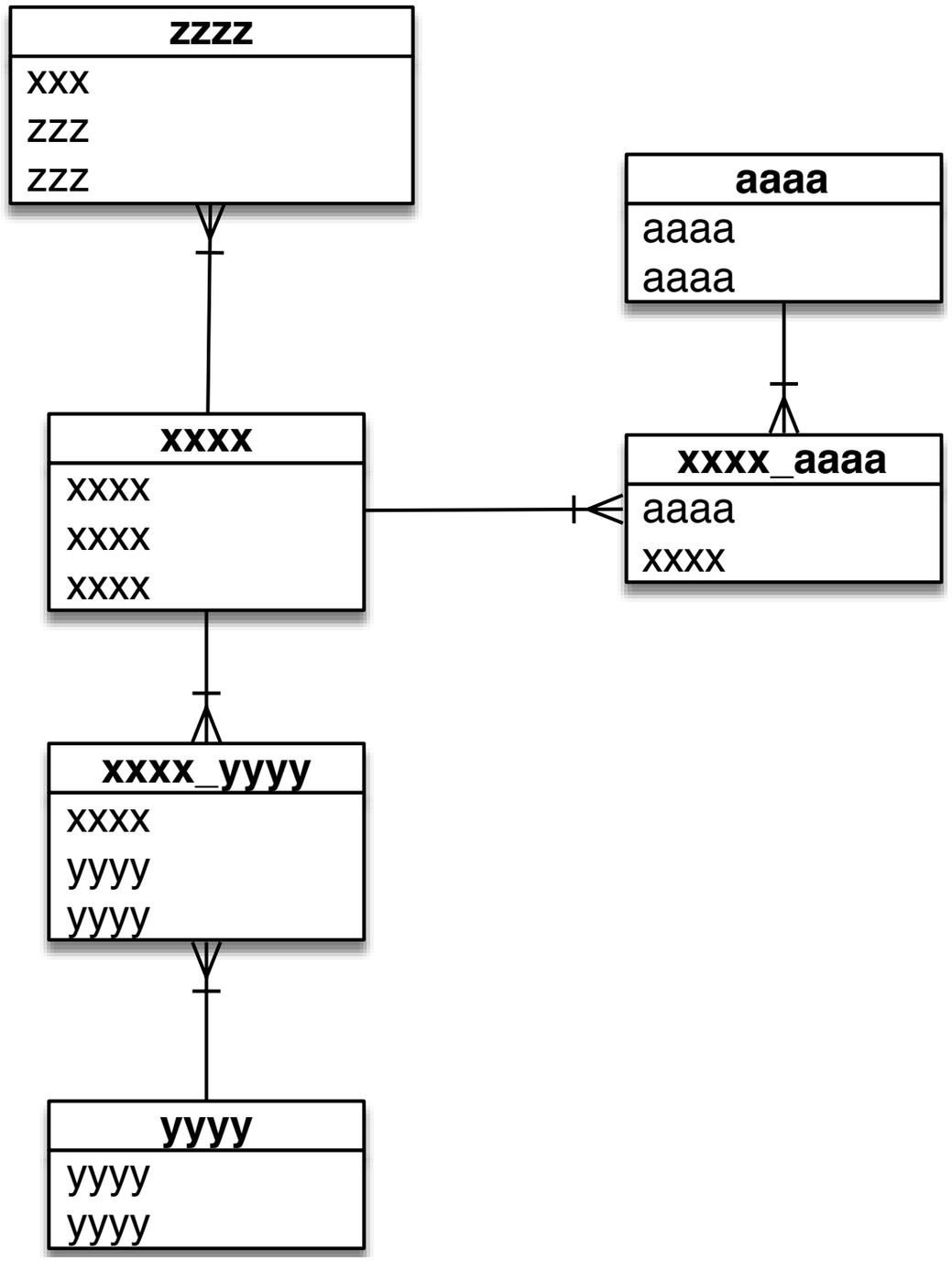
How developers see data

This is driven by most programming languages

```
{
    "name" : "Joe",
    "dept" : "Dev",
    "titles" : [
        { "name": "Junior developer", "from" : "2006-02-01", "until": "2010-10-31" },
        { "name": "Developer", "from" : "2010-11-01", "until": "2012-11-30" },
        { "name": "Team Lead", "from" : "2015-12-01", "until": "2014-11-30" }
    ],
    "salaries" : [
        { "salary" : 5000, "from" : "2006-02-01", "until": "2008-06-30" },
        { "salary" : 5100, "from" : "2008-07-01", "until": "2010-06-30" },
        { "salary" : 5200, "from" : "2010-07-01", "until": "2012-06-30" },
        { "salary" : 5300, "from" : "2011-07-01", "until": "2013-06-30" },
        { "salary" : 5400, "from" : "2012-07-01", "until": "2014-06-30" }
    ]
}
```

DBAs vs. developers

it's a clash of data structures

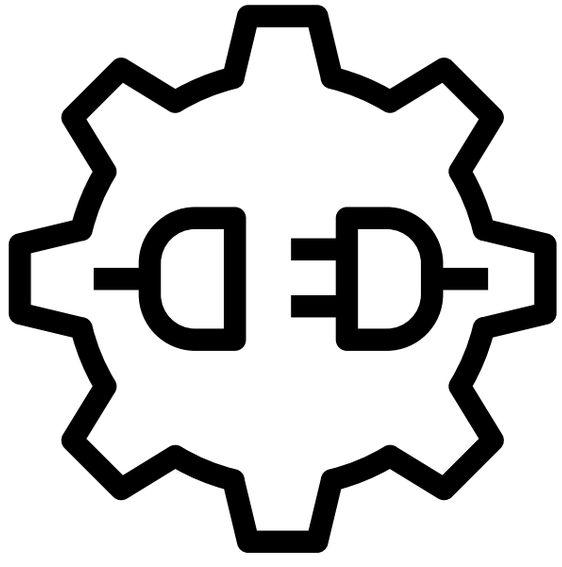



```
xxxx: {
    xxxxxxxx
    aaaaaa,
    yyyyy: {
        yyyyyyyyy,
        yyyyyyyyy,
        yyyyyyyyy
    },
    z:  [
        {  zzzzz,  zzzzz,  zzzz},
        {  zzzzz,  zzzzz,  zzzz},
        {  zzzzz,  zzzzz,  zzzz}
    [
}
```

X- Protocol overview

A new protocol to talk to MySQL

- **extends and replaces the traditional client/server protocol**
- **allows asynchronous communication to the server**
- **uses different API calls**
  - Javascript
  - Python
  - C#
  - Java



Universal API

It should be easy to switch

MySQL Shell **JavaScript** Code

```
// Create a new collection
var myColl = db.createCollection('my_collection');
// Insert a document
myColl.add( { name: 'Sakila', age: 15 } ).execute();
// Insert several documents at once
myColl.add( [
{ name: 'Susanne', age: 24 },
{ name: 'Mike', age: 39 } ] ).execute();
```

Universal API

It looks really easy to switch!

MySQL Shell **Python** Code

```
#  Create a new collection
myColl = db.createCollection('my_collection')
#  Insert a document
myColl.add( { 'name': 'Sakila', 'age':15 } ).execute()
#  Insert several documents at once
myColl.add( [
{ 'name': 'Susanne', 'age': 24 },
{ 'name': 'Mike', 'age' : 39 } ] ).execute()
```

The document store is not in the server by default

- MySQL server does not include the X-protocol
- You need to install a plugin for this
- and you need the MySQL shell (separate product) to use it

!! WARNING !!

The server is GA , but ...

- **The document store comes with MySQL 5.7.12+**
- **HOWEVER**
  - The tools ARE **NOT** GA quality
  - They are, actually, pretty much alpha software
- **Be careful when using it in production**

From the manual

MySQL 5.7 Reference Manual / Using MySQL as a Document Store

version 5.7

Chapter 3 Using MySQL as a Document Store

Table of Contents

3.1 Preproduction Status — Legal Notice
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3.7 X Plugin
3.8 MySQL Shell User Guide

This chapter introduces an alternative way of working with MySQL as a document store, sometimes referred to as "using NoSQL". If your intention is to use MySQL in a traditional (SQL) way, this chapter is probably not relevant to you.

Using MySQL as a document store is currently a preproduction feature to which this notice applies: Section 3.1, "Preproduction Status — Legal Notice".

"Using MySQL as a document store is currently a preproduction feature"

https://dev.mysql.com/doc/refman/5.7/en/document-store.html

Readiness (as of April 2017)

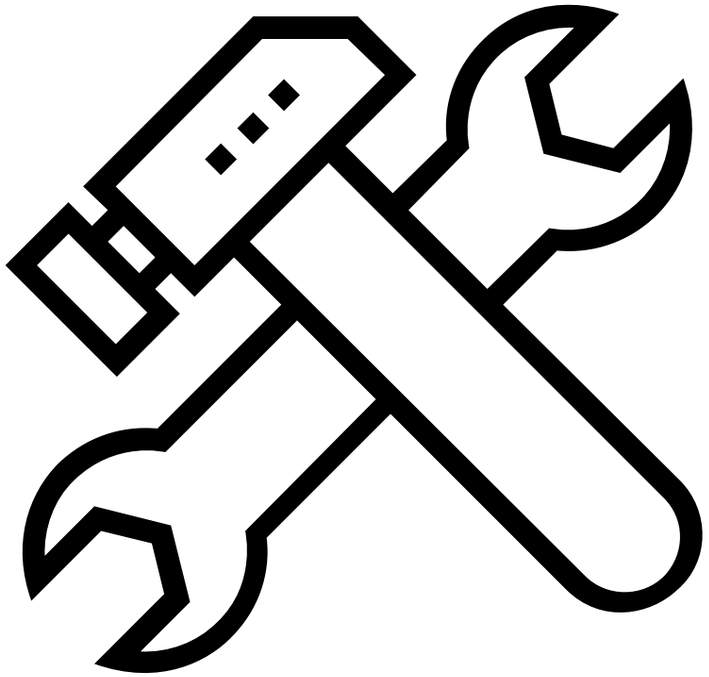
There are several components to the document store

MySQL SERVER 5.7.12+	PLUGIN	SHELL 1.0.8	CONNECTORS
GA	GA	RC	Alpha

```
node.js
java
javascript
python
.net
c++
```

X-Plugin installation

The plugin comes with the server, but you need to enable it



- **Three methods:**
  - with mysqlsh
  - at startup, using --plugin-load=mysqlx=mysqlx.so
  - in SQL, using INSTALL PLUGIN

Method 1 : with mysqlsh

Using the mysql shell itself

```
mysqlsh \
    --classic \
    --user=msandbox \
    --password=msandbox \
    --port=3306 \
    --host=127.0.0.1 \
    --dba enableXProtocol
```

Method 2 : at startup

When we start the server

```
mysqld [...] --plugin-load=mysqlx=mysqlx.so \
    --mysqlx-port=15000
```

```
# or in the configuration file
[mysqld]
# ...
plugin-load=mysqlx=mysqlx.so
mysqlx-port=15000
```

Method 3 : in SQL

At any moment

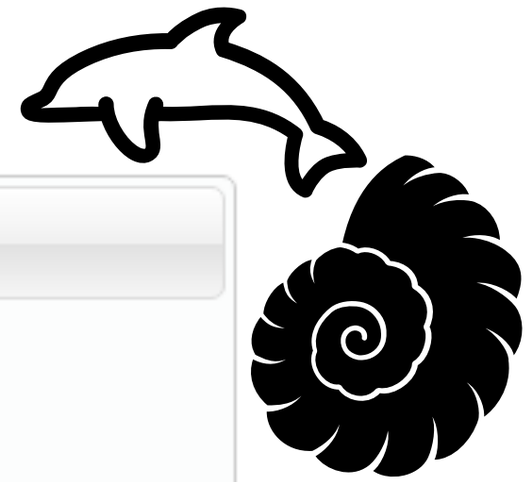
```
install plugin mysqlx soname 'mysqlx.so';
```

Gotchas

- X-Plugin listens to port 33060
- When you install with method 1, you use port 3306
- Afterwards, you use port 33060

MySQL Shell installation

You need the new client to use the new features



Development Releases

MySQL Shell 1.0.8 rc

Select Operating System:

Mac OS X

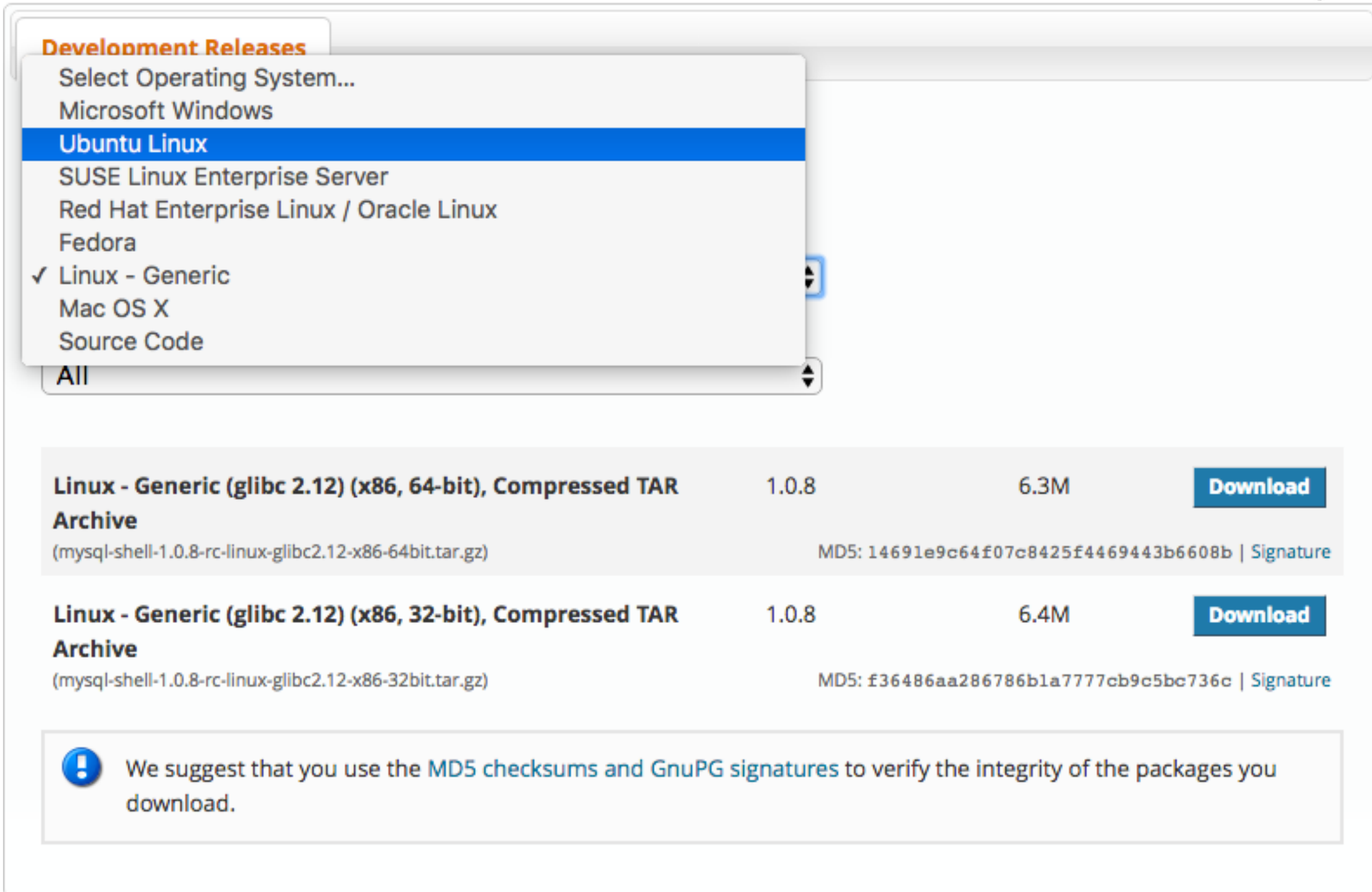
Packages for Sierra (10.12) are compatible with El Capitan (10.11)

Mac OS X 10.12 (x86, 64-bit), DMG Archive	1.0.8	5.0M	Download
(mysql-shell-1.0.8-rc-macos10.12-x86-64bit.dmg)	MD5: ab47029fed09bff2ef7fb49f4a2b37d0 | Signature		
Mac OS X 10.12 (x86, 64-bit), Compressed TAR Archive	1.0.8	4.8M	Download
(mysql-shell-1.0.8-rc-macos10.12-x86-64bit.tar.gz)	MD5: 7ddb7f09de411080ce9ec22266598cbe | Signature		

We suggest that you use the MD5 checksums and GnuPG signatures to verify the integrity of the packages you download.

MySQL Shell installation

There are packages for most operating systems



Shell with Docker

Instead of installing ...

MySQL shell image not updated since 11 months ago

- Using a Docker image
- Shell ready to use
- No side effects

However ...

Using the latest mysqlsh release, there is a workaround

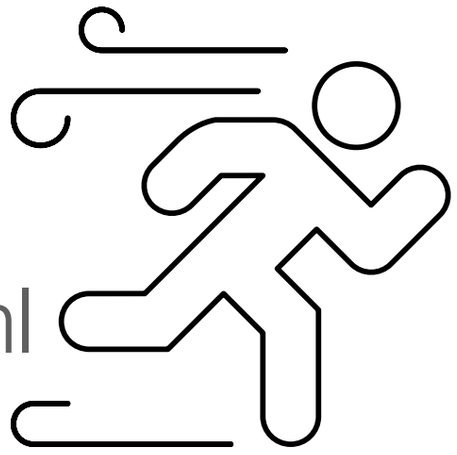
```
docker run -d \
   -v $PWD/mysql-shell/bin/mysqlsh:/usr/bin/mysqlsh  \
   -v ~/data:/data \
   --name mybox \
   -e MYSQL_ROOT_PASSWORD=secret \
   mysql/mysql-server

docker run -ti mybox bash
```

Getting started

Let's practice with real data

- **Install MySQL 5.7.18**
- **load plugin**
- **Download the world_x database**
  - https://dev.mysql.com/doc/index-other.html
- **load the database**
- **connect using mysql shell**



Examples with the shell

Getting ready

```
make_sandbox 5.7.17 -- --load_plugin=mysqlx \
-c general_log=1
[...]
#Sandbox server installed in $HOME/sandboxes/msb_5_7_17

sudo netstat -atn | grep LISTEN | grep '5714\|33060'
#tcp4       0      0  *.33060                *.*     LISTEN
#tcp4       0      0  127.0.0.1.57147        *.*     LISTEN

 $HOME/sandboxes/msb_5_7_17/use \
    < $HOME/data/world_x-db/world_x.sql
```

As seen from the old client

Some things have two faces

```
~/sandboxes/msb_5_7_17/use world_x

mysql [localhost] {msandbox} (world_x) > show tables;
+--------------------+
| Tables_in_world_x |
+--------------------+
| City               |
| Country            |
| CountryInfo        |
| CountryLanguage    |
+--------------------+
4 rows in set (0.00 sec)
```

And from the new client (1)

Welcome to the machine!

```
$ mysqlsh \
  --uri msandbox:msandbox@127.0.0.1:33060/world_x
Creating a Session to 'msandbox@127.0.0.1:33060/
world_x'
Node Session successfully established. Default schema
`mysql_x` accessible through db.
Welcome to MySQL Shell 1.0.8-rc

[...]

Type '\help', '\h' or '\?' for help, type '\quit' or
'\q' to exit.

Currently in JavaScript mode. Use \sql to switch to
SQL mode and execute queries.
mysql-js>
```

And from the new client (2)

Welcome to the machine!

```
mysql-js> db.getTables()
{
    "City": <Table:City>,
    "Country": <Table:Country>,
    "CountryLanguage": <Table:CountryLanguage>
}
mysql-js> db.getCollections()
{
    "CountryInfo": <Collection:CountryInfo>
}
mysql-js>
```

Starting something new

Schema-less!

```
mysql-js> nc=db.createCollection('person')
<Collection:person>
mysql-js>
mysql-js> db.getCollections()
{
    "CountryInfo": <Collection:CountryInfo>,
    "person": <Collection:person>
}
mysql-js>
```

Inserting data

REALLY schema-less!

```
mysql-js> nc.add({ name: "Joe", city: "Paris"})
Query OK, 1 item affected (0.00 sec)

mysql-js> nc.add({ name: "Frank", where_are_you_from:
"London"})
Query OK, 1 item affected (0.01 sec)
```

Retrieving data

This reminds me of something ...

```
mysql-js> nc.find()
[
    {
        "_id": "6eee6f07ab66e611564dfeeead98f1ef",
        "name": "Frank",
        "where_are_you_from": "London"
    },
    {
        "_id": "94b470f7aa66e611564dfeeead98f1ef",
        "city": "Paris",
        "name": "Joe"
    }
]
2 documents in set (0.00 sec)
```

Back to the old side

The general log shows what we were doing

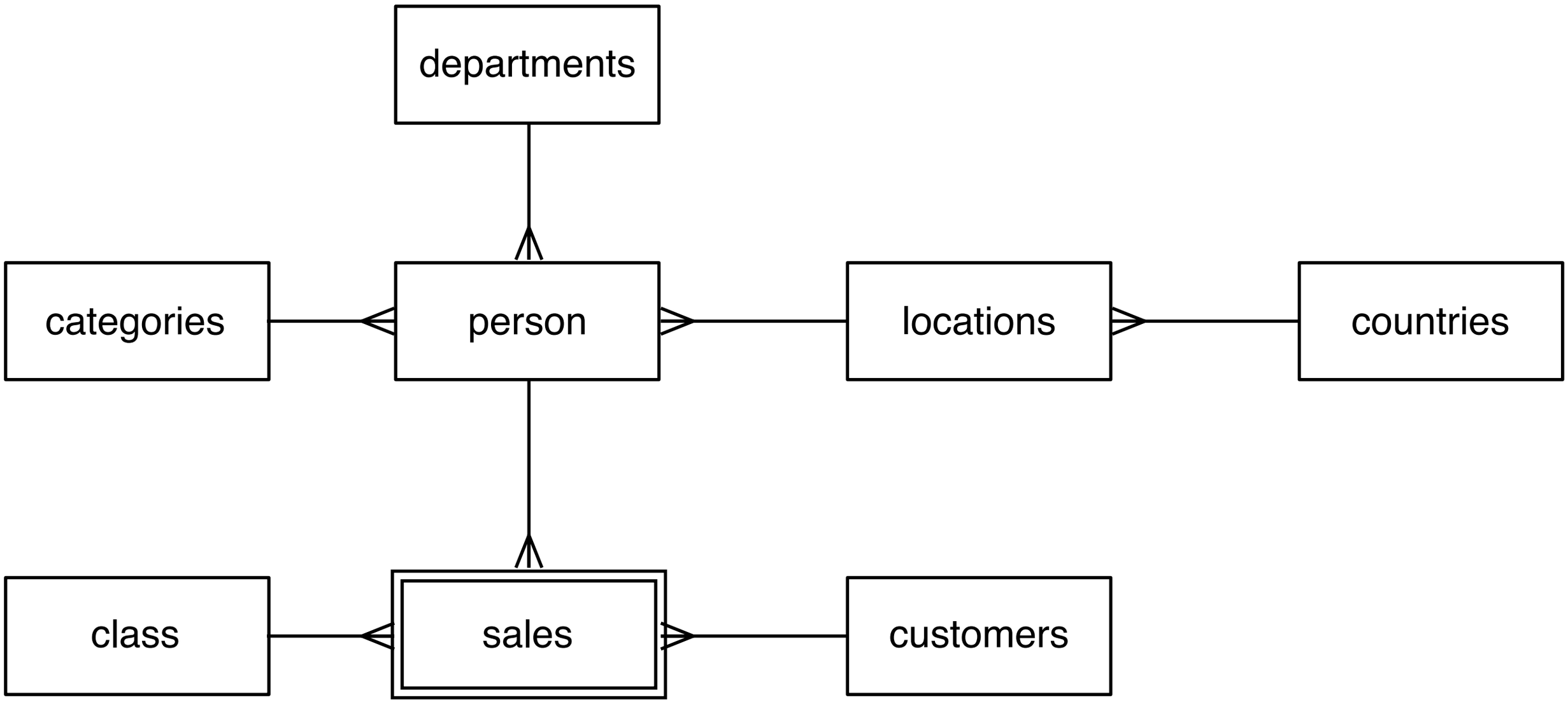
```
CREATE TABLE `world_x`.`person` (doc JSON,_id
VARCHAR(32) GENERATED ALWAYS AS
(JSON_UNQUOTE(JSON_EXTRACT(doc, '$._id'))) STORED
PRIMARY KEY) CHARSET utf8mb4 ENGINE=InnoDB

 Query INSERT INTO `world_x`.`person` (doc) VALUES
('{\"_id\":\"94b470f7aa66e611564dfeeead98f1ef\",\"city
\":\"Paris\",\"name\":\"Joe\"}')

Query INSERT INTO `world_x`.`person` (doc) VALUES
('{\"_id\":\"6eee6f07ab66e611564dfeeead98f1ef\",\"name
\":\"Frank\",\"where_are_you_from\":\"London\"}')
```

A complex example

A classical organization with sales



SQL to JSON (1)

The classical organization as a SQL result

```
select name, sale_date, sale_amount as '$$$', customer,
class_name
from person
  inner join sales using (person_id)
  inner join customers using (customer_id)
  inner join class c on (c.class_id = sales.class_id);
+---------+-------------+--------+---------------+-------------+
| name    | sale_date   | $$$    | customer      | class_name  |
+---------+-------------+--------+---------------+-------------+
| Frank   | 2003-10-01  | 23000  | DataSmart     | software    |
| Frank   | 2003-10-12  | 45000  | NewHardware   | hardware    |
| Frank   | 2003-11-04  | 60000  | DataSmart     | services    |
| Susan   | 2003-11-02  | 25000  | ViewData      | software    |
| Susan   | 2003-10-13  | 18000  | SmartEdu      | services    |
| Martin  | 2003-10-12  | 50000  | SmartEdu      | hardware    |
+---------+-------------+--------+---------------+-------------+
```

SQL to JSON (2)

The classical organization as a collection of documents

```
{
    "_id": 3,
    "country": "Germany",
    "category": "employee",
    "location": "Bonn",
    "name": "Frank",
    "salary": 5000,
    "gender": "m",
    "department": "sales",
    "sales" : [
        {
            "class_name": "software",
            "sale_date": "2003-10-01",
            "customer": "DataSmart",
            "sale_amount": 23000
        },
        {
            "class_name": "hardware",
            "sale_date": "2003-10-12",
            "customer": "NewHardware",
            "sale_amount": 45000
        },
        {
            "class_name": "services",
            "sale_date": "2003-11-04",
            "customer": "DataSmart",
            "sale_amount": 60000
        }
        ]
},
```

```
{
    "_id": 3,
    "country": "Germany",
    "category": "employee",
    "location": "Bonn",
    "name": "Frank",
    "salary": 5000,
    "gender": "m",
    "department": "sales",
    "sales" : [
        {
            "class_name": "software",
            "sale_date": "2003-10-01",
            "customer": "DataSmart",
            "sale_amount": 23000
        },
```

A bigger collection

The world_x database comes with some beefy data

```
mysql-js> db.getCollections()
{
    "CountryInfo": <Collection:CountryInfo>,
    "person": <Collection:person>
}

mysql-js> ci=db.getCollection('CountryInfo')
<Collection:CountryInfo>
```

Sample data from world_x

The data is in layers

```
mysql-js> ci.find().limit(1)
[
    {
        "GNP": 828,
        "IndepYear": null,
        "Name": "Aruba",
        "_id": "ABW",
        "demographics": {
            "LifeExpectancy": 78.4000015258789,
            "Population": 103000
        },
        "geography": {
            "Continent": "North America",
            "Region": "Caribbean",
            "SurfaceArea": 193
        },
        "government": {
            "GovernmentForm": "Nonmetropolitan Territory of The Netherlands",
            "HeadOfState": "Beatrix"
        }
    }
]
```

Complex queries are possible

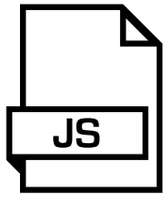
Not always easy to get

```
mysql-js> db.collections.CountryInfo.find("government.HeadOfState='Elisabeth II' AND geography.Continent = 'Oceania
' AND demographics.Population > 150000").fields(["Name", "demographics.Population","geography.Continent"])
[
    {
        "Name": "Australia",
        "demographics.Population": 18886000,
        "geography.Continent": "Oceania"
    },
    {
        "Name": "New Zealand",
        "demographics.Population": 3862000,
        "geography.Continent": "Oceania"
    },
    {
        "Name": "Papua New Guinea",
        "demographics.Population": 4807000,
        "geography.Continent": "Oceania"
    },
    {
        "Name": "Solomon Islands",
        "demographics.Population": 444000,
        "geography.Continent": "Oceania"
    }
]
4 documents in set (0.00 sec)
```

Examples: to and from MongoDB

Since they are both schema-less ...

- **From MySQL to MongoDB**
  - extract data from a document store
  - feed it to MongoDB
- **From MongoDB to MySQL**
  - create collection
  - extract data
  - filter off the oddities
  - feed it to MySQL shell



From MySQL to Mongoldb (1)

Extracting data

```
// extract.py
import mysqlx
import json
session = mysqlx.get_session( ... )
schema     = session.get_schema('world_x')
collection = schema.get_collection('CountryInfo')
result     = collection.find().execute()
docs       = result.fetch_all()

for doc in docs:
    doc = dict(doc)
    print(json.dumps(doc, indent=4))

session.close()

# python extract.py > /data/country_info.json
```

From MySQL to Mongoldb (2)

import data to mongoldb

```
mongoimport --db test --collection countries \
    --drop --file /data/country_info.json
```

From MongoDB to MySQL (1)

First create the collection

```
mysql-js> db.createCollection('restaurants')
```

From MongoDB to MySQL (2)

Export the data from MongoDB

```
docker exec -ti mongo mongo --quiet \
    --eval 'DBQuery.shellBatchSize=300; var
all=db.restaurants.find() ; all' \
    | perl -pe 's/(?:ObjectId|ISODate)\(("[^"]+")\)/
$1/g' \
    > all_recs.json
```

Why do we need to filter

There is data like this:

```
{
        "_id" : ObjectId("57b81d385957bb0d60511ce5"),
        "borough" : "Bronx",
        "cuisine" : "Bakery",
        "grades" : [
           {
              "date" : ISODate("2014-03-03T00:00:00Z"),
              "grade" : "A",
              "score" : 2
           },
        ],
        "name" : "Morris Park Bake Shop",
        "restaurant_id" : "30075445"
}
```

Importing into MySQL

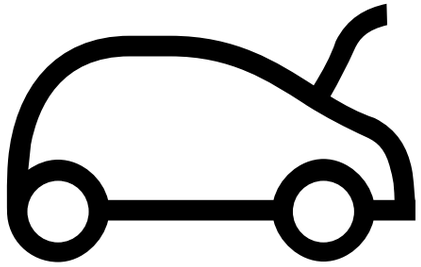
```
schema = session.get_schema('test')
collection = schema.create_collection('restaurants')

with open('all_recs.json', 'r') as json_data:
    for line in json_data:
        skip=re.match('Type', line)
        if not skip:
            rec = json.loads(line)
             collection.add(rec).execute()
```

A look inside

What's a MySQL Document?

- **mysqlsh calls it a "collection"**
- **mysql calls it a table**
  - with a GENERATED **_id** field
  - with a json field



mysql

The old client view

```
show tables;
+--------------------+
| Tables_in_world_x |
+--------------------+
| City               |
| Country            |
| CountryInfo        |
| CountryLanguage    |
+--------------------+
4 rows in set (0.00 sec)
```

mysqlsh

The document store view

```
mysql-js> db.getCollections()
{
    "CountryInfo": <Collection:CountryInfo>
}
mysql-js> db.getTables()
{
    "City": <Table:City>,
    "Country": <Table:Country>,
    "CountryLanguage": <Table:CountryLanguage>
}
```

mysql

The old client view

```
show create table CountryInfo\G
******* 1. row ***************************
       Table: CountryInfo
Create Table: CREATE TABLE `CountryInfo` (
  `doc` json DEFAULT NULL,
  `_id` varchar(32) GENERATED ALWAYS AS
(json_unquote(json_extract(`doc`,'$._id'))) STORED
) ENGINE=InnoDB DEFAULT CHARSET=utf8
1 row in set (0.00 sec)
```

general log

The "truth"

```
SELECT C.table_name AS name,
IF(ANY_VALUE(T.table_type)='VIEW', 'VIEW', IF(COUNT(*)
= COUNT(CASE WHEN (column_name = 'doc' AND data_type =
'json') THEN 1 ELSE NULL END) + COUNT(CASE WHEN
(column_name = '_id' AND generation_expression =
'json_unquote(json_extract(`doc`,''$._id''))') THEN 1
ELSE NULL END) + COUNT(CASE WHEN (column_name != '_id'
AND generation_expression RLIKE '^(json_unquote[[.
(.]])?json_extract[[.(.]]`doc`,''[[.$.]]([[...]]
[^[:space:][...]]+)+''[[.).]]{1,2}$') THEN 1 ELSE NULL
END), 'COLLECTION', 'TABLE')) AS type FROM
information_schema.columns AS C LEFT JOIN
information_schema.tables AS T USING (table_name)WHERE
C.table_schema = 'world_x' GROUP BY C.table_name ORDER
BY C.table_name
```

how x-plugin finds "collections"

I'd say it needs more integration

```
SELECT C.table_name AS name, IF(ANY_VALUE(T.table_type)='VIEW', 'VIEW',
IF(COUNT(*) = COUNT(CASE WHEN (column_name = 'doc' AND data_type = 'json') THEN 1
ELSE NULL END) + COUNT(CASE WHEN (column_name = '_id' AND generation_expression =
'json_unquote(json_extract(`doc`,''$._id''))') THEN 1 ELSE NULL END) + COUNT(CASE
WHEN (column_name != '_id' AND generation_expression RLIKE '^(json_unquote[[.
(.]])?json_extract[[.(.]]`doc`,''[[.$.]]([[...]][^[:space:][...]]+)+''[[.).]]
{1,2}$') THEN 1 ELSE NULL END), 'COLLECTION', 'TABLE')) AS type FROM
information_schema.columns AS C LEFT JOIN information_schema.tables AS T USING
(table_name)WHERE C.table_schema = 'world_x' GROUP BY C.table_name ORDER BY
C.table_name
```

name	type
City	TABLE
Country	TABLE
CountryInfo	**COLLECTION**
CountryLanguage	TABLE

More with mysql shell

A few tricks that could be useful

- **Using mysqlsh to export in JSON format from regular MySQL tables**
- **Running mysqlsh in Docker without a dedicated container.**

Examples

where to find the examples used in this presentation

https://github.com/datacharmer/mysql-document-store

Q & A