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MySQL Document Store *Tutorial*

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Tutorial

Workbook

A workbook with supporting text for the slide presentation and some extras is available at
<https://github.com/davidmstokes/preFOSDEM>
as a PDF file

Software

If you would like to follow along with the examples & perform the exercises, you will need to have a copies of MySQL Server and MySQL shell installed on your laptop (latest version please) plus a copy of the world_x database for the last part of the tutorial.



Our Goal

To show you how easy it is to use the MySQL Document Store!

No need to normalize data, setup schemas, or indexes BEFORE you can save your data.

Why this matters

“Go ahead a start coding and we will tell you want you are working on later...”

“Can we add this field to the data?”

“Uh, this SQL thing? Is it a pizza topping?”

What We Are Going to Do

- Two much of Dave talking
- Examples
- Exercises
- Much more Dave talking
- Your questions – always welcome



Benefits

One Database

No need to maintain the same data in SQL and JSON NoSQL.

Transactions

ACID Compliance for data consistency and easy management.

High Availability

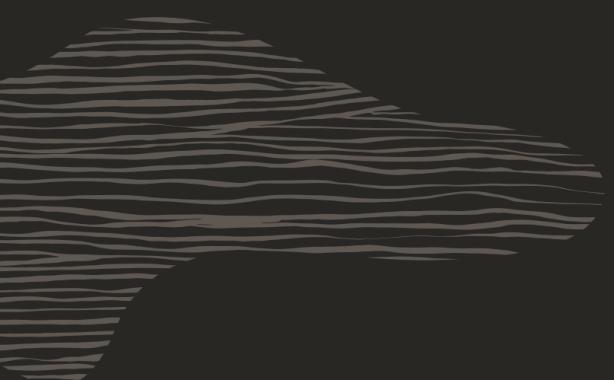
Use MySQL Group Replication to scale reads and automatic failover in case master server fails.

Secure by Default

MySQL 8.0 is secure by default and there is the option to use the Enterprise Edition's Transparent Data Encryption.

So what does a NoSQL MySQL look like? Page 2

```
MySQL localhost:33060+ ssl fosdem JS > \use fosdem
Default schema `fosdem` accessible through db.
MySQL localhost:33060+ ssl fosdem JS > db
<Schema:fosdem>
MySQL localhost:33060+ ssl fosdem JS > db.createCollection('a')
<Collection:a>
MySQL localhost:33060+ ssl fosdem JS > db.a
<Collection:a>
MySQL localhost:33060+ ssl fosdem JS > db.a.add( { foo: "bar" } )
Query OK, 1 item affected (0.0062 sec)
MySQL localhost:33060+ ssl fosdem JS > db.a.find()
{
  "_id": "00005df0ed91000000000000000002",
  "foo": "bar"
}
1 document in set (0.0005 sec)
```



- It is very simple to connect to a MySQL server, create a collection, and add a document without using SQL

Creating a Schema

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```
MySQL localhost:33060+ ssl f schema JS > session.createSchema('demo')
<Schema:demo>
MySQL localhost:33060+ ssl f JS > \use demo
Default schema `demo` accessible through db.
MySQL localhost:33060+ ssl demo JS > db
<Schema:demo>
```

- Once you have logged in a create a session, it is very simple to create a schema to house collections of document.

Now we can create a collection of documents

```
MySQL | localhost:33060+ > db.createCollection('names');
<Collection:names>
MySQL | localhost:33060+ ssl | demo | JS > db.names.add( { "name" : "Dave", home: "Texas"})
Query OK, 1 item affected (0.0145 sec)
MySQL | localhost:33060+ ssl | demo | JS > db.names.find()
{
  "_id": "00005e20838d00000000000000000001",
  "home": "Texas",
  "name": "Dave"
}
1 document in set (0.0005 sec)
MySQL | localhost:33060+ ssl | demo | JS >
```

- Let us start with a collection to keep documents with information

Data is added

- Data in the form a of JSON Document is added to the collection

```
MySQL [localhost:33060+ ssl] demo [JS] > db.createCollection('names');
<Collection:names>
MySQL [localhost:33060+ ssl] demo [JS] > db.names.add( { "name" : "Dave", home: "Texas"})
Query OK, 1 item affected (0.0143 sec)
MySQL [localhost:33060+ ssl] demo [JS] > db.names.find()
{
  "_id": "00005e20838d00000000000000000001",
  "home": "Texas",
  "name": "Dave"
}
1 document in set (0.0005 sec)
MySQL [localhost:33060+ ssl] demo [JS] >
```

Query the data

- The data is returned in JSON format with the data entered previously and a new `_id` fields

```
MySQL [localhost:33060+ ssl demo JS] > db.createCollection('names');
<Collection:names>
MySQL [localhost:33060+ ssl demo JS] > db.names.add( { "name" : "Dave", home: "Texas"})
Query OK, 1 item affected (0.0145 sec)
MySQL [localhost:33060+ SSL demo JS] > db.names.find()
{
  "_id": "00005e20838d000000000000000001",
  "home": "Texas",
  "name": "Dave"
}
1 document in set (0.0005 sec)
MySQL [localhost:33060+ ssl demo JS] >
```

_id

For now we are going to ignore the _id field

But it will be explained later



All this was done without an Structured Query Language (SQL)

```
MySQL | localhost:33060+ ssl | demo | JS > db.createCollection('names');
<Collection:names>
MySQL | localhost:33060+ ssl | demo | JS > db.names.add( { "name" : "Dave", home: "Texas"})
Query OK, 1 item affected (0.0145 sec)
MySQL | localhost:33060+ ssl | demo | JS > db.names.find()
{
  "_id": "00005e20838d000000000000000001",
  "home": "Texas",
  "name": "Dave"
}
1 document in set (0.0005 sec)
MySQL | localhost:33060+ ssl | demo | JS >
```

- The X DevAPI uses modern programming structure, avoiding the often confusing syntax of SQL

Adding another document is easy

Page 4

-
- The nature of JSON Documents is schema less – so the new document can have different key/value pairs

```
MySQL [localhost:33060+ ssl] demo> db.names.add( { name: "Jack", age: 11 } )  
Query OK, 1 item affected  
MySQL [localhost:33060+ ssl] demo> db.names.find().fields("name")  
{  
  "name": "Dave"  
}  
{  
  "name": "Jack"  
}  
2 documents in set (0.0007 sec)
```

The `find()` can provide selected key/values

- The `find()` is a very powerful tool

```
MySQL localhost:33060+ ssl [ demo JS ] > db.names.add( { name: "Jack", age: 11 } )  
Query OK, 1 item affected (0.0116 sec)  
MySQL localhost:33060+ s! > db.names.find().fields("name")  
{  
  "name": "Dave"  
}  
{  
  "name": "Jack"  
}  
2 documents in set (0.0007 sec)
```

Exercise 1

Create a schema named '**fosdem**', a collection named '**a**', and add your name and another piece of information. What is needed for quoting keys and what is needed for quoting values?

Time - 10 minutes



Exercise 1 Review – How did you do?



A Very Quick Explanation of JSON objects and JSON arrays

- Objects are bounded by {}, arrays are bounded by [].
- You can have arrays in objects, objects in arrays, in any combo you want.
- You can embed down as many levels as you want but discretion is advised as they get harder to read as you add more.
- The MySQL JSON data type will hold roughly 1GB per column.

See <https://www.json.org/json-en.html> for more details on JSON.



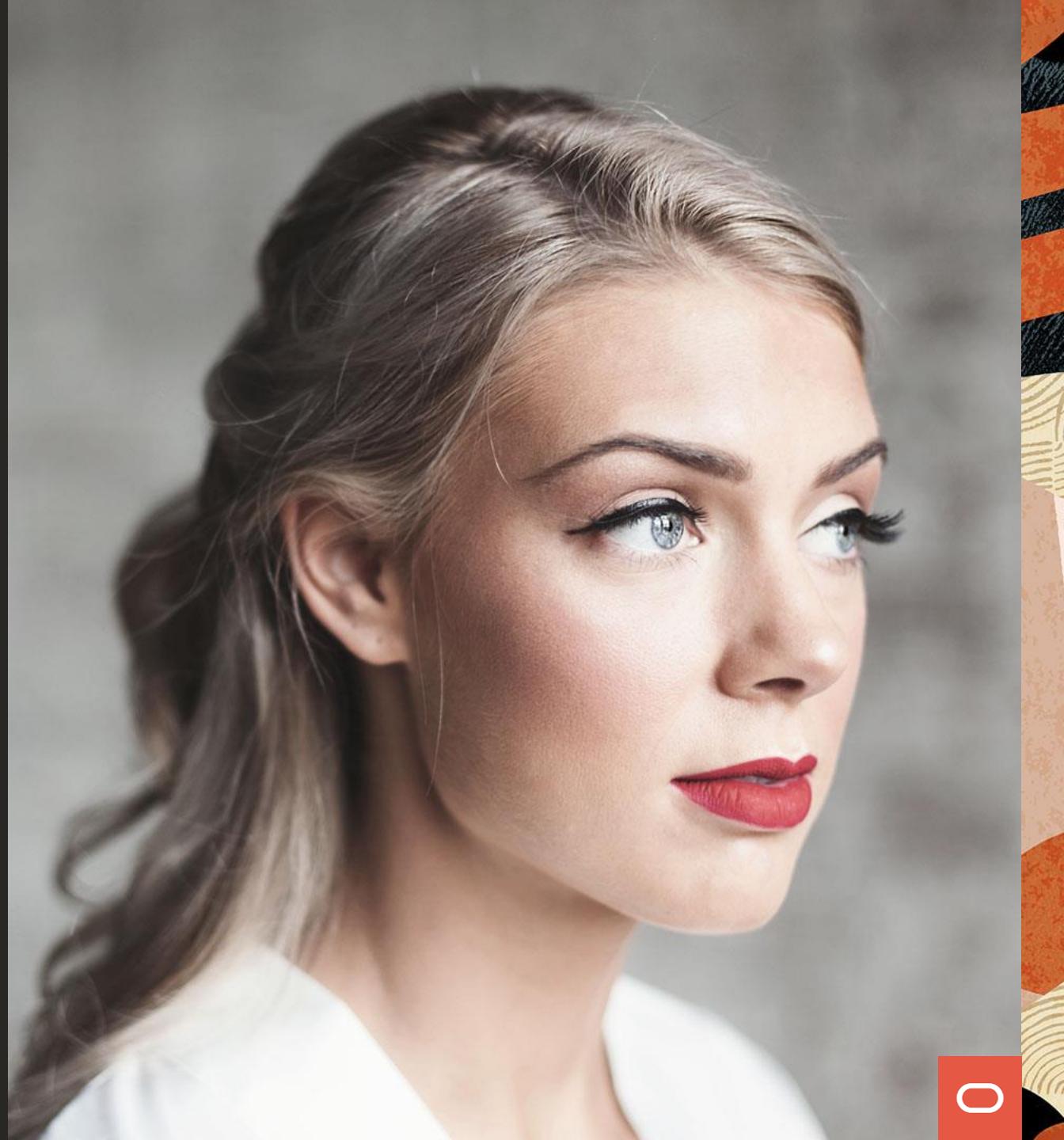
```
{  
  "GNP": 249704,  
  "_id": "BEL",  
  "Name": "Belgium",  
  "IndepYear": 1830,  
  "geography": {  
    "Region": "Western Europe",  
    "Continent": "Europe",  
    "SurfaceArea": 30518  
  },  
  "government": {  
    "HeadOfState": "Albert II",  
    "GovernmentForm": "Constitutional Monarchy, Federation"  
  },  
  "demographics": {  
    "Population": 10239000,  
    "LifeExpectancy": 77.80000305175781  
  }  
}
```

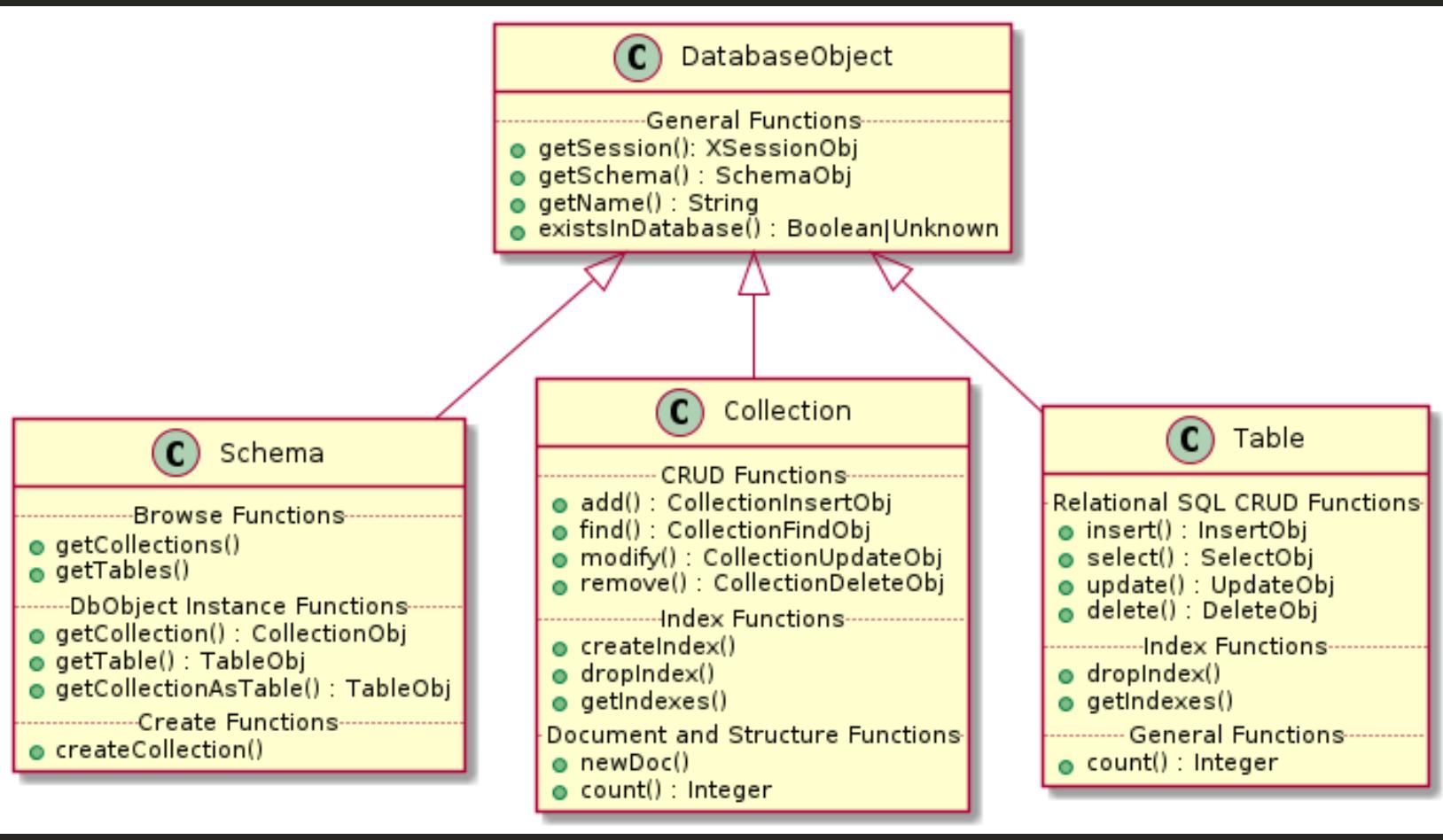
This is an example JSON document showing embedding



**Ready for some technical stuff &
a generic stock photo?**

Then this is
your *lucky* day!





The MySQL Document Store allows developers to work with SQL relational tables and schema-less JSON collections.

To make that possible MySQL has created the X Protocol and the X Dev API which puts a strong focus on CRUD by providing a fluent API allowing you to work with JSON documents in a natural way.

The X Protocol is a highly extensible and is optimized for CRUD as well as SQL API operations.

The X DevAPI is implemented by MySQL Shell and MySQL Connectors that support X Protocol.

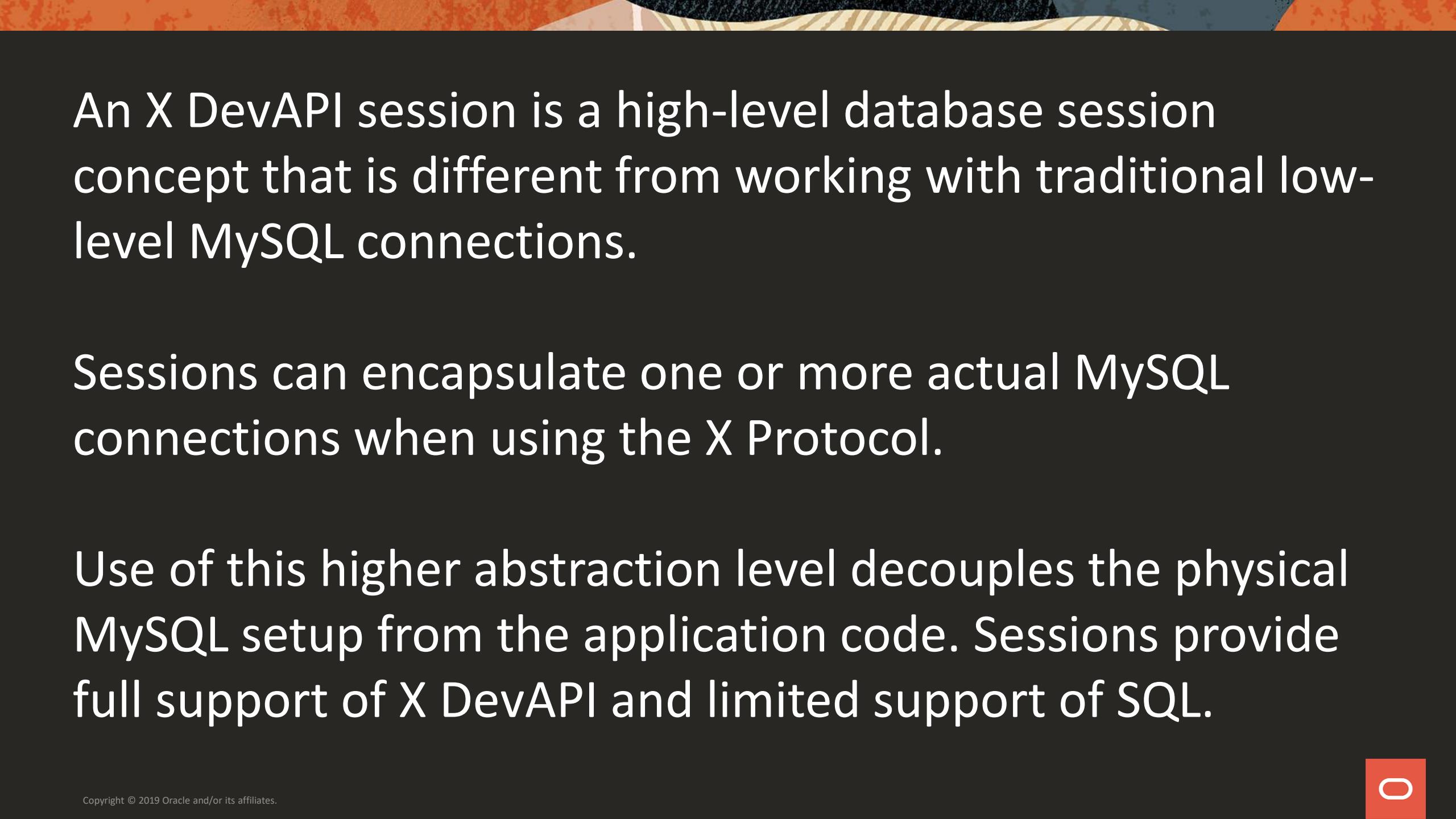
The X DevAPI wraps several very powerful concepts in a simple API.

- A new high-level session concept enables you to write code that can transparently scale from single MySQL Server to a multiple server environment with InnoDB Cluster
- Read operations are simple and easy to understand.
- Non-blocking, asynchronous calls follow common host language patterns.

The X DevAPI introduces a new, modern and easy-to-learn way to work with your data.

- Documents are stored in Collections and have their dedicated CRUD operation set.
- Work with your existing domain objects or generate code based on structure definitions for strictly typed languages.
- Focus is put on working with data via CRUD operations.
- Modern practices and syntax styles are used to get away from traditional SQL-String-Building.





An X DevAPI session is a high-level database session concept that is different from working with traditional low-level MySQL connections.

Sessions can encapsulate one or more actual MySQL connections when using the X Protocol.

Use of this higher abstraction level decouples the physical MySQL setup from the application code. Sessions provide full support of X DevAPI and limited support of SQL.



So what is wrong with good ol' SQL?!?!

Descriptive
Language

Impedance
Mismatch

ORMS and other
similar problems



A New Port!

The X DevAPI listens on port 33060 instead of the older protocols 3306.

MySQL 8.0 has the X DevAPI enabled by default and it is optional on MySQL 5.7.

Creating a Session

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```
MySQL Shell 8.0.18

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Other names may be trademarks of their respective owners.

Type '\help' or '\?' for help; '\quit' to exit.
\c root@localhost
Creating session to 'root@localhost'
Fetching schema names for autocomplete... Press ^C to stop.
Your MySQL connection id is 10 (X protocol)
Server version: 8.0.18 MySQL Community Server - GPL
No default schema selected; type \use <schema> to set one.
MySQL localhost:33060+ ssl JS > session.createSchema('xtest')
<Schema:xtest>
MySQL localhost:33060+ ssl JS > session.setCurrentSchema('xtest')
<Schema:xtest>
```

- To start using the MySQL Document store you have to create a session by logging into the server.



Creating a Schema

- Creating a schema is done with `createSchema()`

```
MySQL Shell 8.0.18

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Other names may be trademarks of their respective owners.

Type '\help' or '\?' for help; '\quit' to exit.
MySQL JS > \c root@localhost
Creating a session to 'root@localhost'
Fetching schema names for autocomplete... Press ^C to stop.
Your MySQL connection id is 10 (X protocol)
Server version: 8.0.18 MySQL Community Server - GPL
No default schema selected; type '\use <schema>' to set one.
MySQL localhost:33060+ ssl JS > session.createSchema('xtest')
<Schema:xtest>
MySQL localhost:33060+ ssl JS > session.setCurrentSchema('xtest')
<Schema:xtest>
```

Pointing to a Schema

```
MySQL Shell 8.0.18

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Other names may be trademarks of their respective owners.

Type '\help' or '\?' for help; '\quit' to exit.
MySQL JS > \c root@localhost
Creating a session to 'root@localhost'
Fetching schema names for autocomplete... Press ^C to stop.
Your MySQL connection id is 10 (X protocol)
Server version: 8.0.18 MySQL Community Server - GPL
No default schema selected; type \use <schema> to set one.
MySQL localhost:33060+ ssl JS > session.createSchema('xtest')
<Schema:xtest>
MySQL localhost:33060+ ssl JS > session.setCurrentSchema('xtest')
<Schema:xtest>
```

- To get the session to point to the new schema we can use \USE xtest or
session.setCurrentSchema('xtest')

Create a Collection

- So let us create a new collection very creatively named 'a'

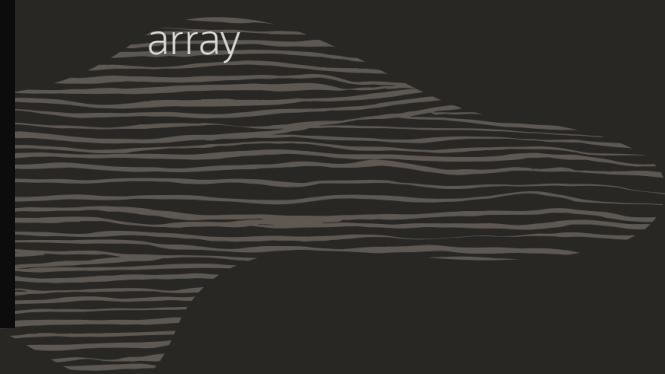
```
MySQL localhost:33060+ ssl JS > \use xtest
Default schema `xtest` accessible through db.
MySQL localhost:33060+ ssl xtest JS > db
<Schema:xtest>
MySQL localhost:33060+ ssl JS > db.createCollection('a')
<Collection:a>
MySQL localhost:33060+ ssl xtest JS > db.a.add(
    -> {
    ->   "foo"  : "bar",
    ->   "_id"   : 12345,
    ->   "a_ray" : [1,3,5,7]
    -> }
    -> )
    ->
Query OK, 1 item affected (0.0078 sec)
```



Create a Collection

- And add a document
- Note: the `_id` field is specified and there is an array

```
MySQL localhost:33060+ ssl JS > \use xtest
Default schema `xtest` accessible through db.
MySQL localhost:33060+ ssl xtest JS > db
<Schema:xtest>
MySQL localhost:33060+ ssl xtest JS > db.createCollection('a')
<Collection:a>
MySQL localhost:33060+ ssl JS > db.a.add(
-> {
->   "foo"  : "bar",
->   "_id"  : 12345,
->   "a_ray" : [1,3,5,7]
-> }
-> )
->
Query OK, 1 item affected (0.0078 sec)
```



And let us find that particular record

- We can specify the search parameters by putting them into the `find()`

```
MySQL localhost:33060+ ssl db.a.find("_id = 12345").fields('foo')  
{  
    "foo": "bar"  
}  
1 document in set (0.0007 sec)
```

- We can use modify() to add additional key/values to the document

And let us modify that particular record

```
MySQL localhost:33060+ ssl db.a.modify("_id = 12345").set('Location:', { city: 'Brussels', CountryCode: 'BEL'})  
Query OK, 1 item affected (0.0046 sec)  
Rows matched: 1  Changed: 1  Warnings: 0
```

And let us check that modification

- Note that we are specifying two fields in this illustration

```
MySQL [localhost:33060+ s] → db.a.find("_id = 12345").fields('foo','Location')
{
  "foo": "bar",
  "Location": {
    "city": "Brussels",
    "CountryCode": "BEL"
  }
}
+-----+-----+-----+
```

Exercise 2

Create a schema named **demox**, create a document collection in that schema named **a**, and create a document with your name and postal code as data.

Then modify the document to another key/value pair with **shoeSize** as the key and your shoe size as the data.

Time - 15 minutes



Exercise Review

What was your experience?



Group Exercise

Page 11 using 'a' collectio

Does `db.a.find("_id = 12345").fields('foo','Location")` work with mixed single and double quotes?

What if you run `db.a.modify("_id = 12345").set('location:', { city: 'Brussels', CountryCode: 'BEL'})` -- do you get two key/values or is it case insensitive?

Time - 15 minutes



CRUD operations are available as methods, which operate on Schema objects. The available Schema objects consist of Collection objects containing Documents, or Table objects consisting of rows and Collections containing Documents.

Operation	Document Store	Relational
Create	Connection.add()	Table.insert()
Read	Connection.find()	Table.select()
Update	Connection.modify()	Table.update()
Delete	Connection.remove()	Table.delete()

POP Quiz

What is the query for deleting a document from a collection named ‘z’ in a schema named ‘cars’ where the _id = 123?



Transactions

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- Lets add another document to the 'a' collection

```
MySQL localhost:33060+ ssl xtest JS > session.beginTransaction()
Query OK, 0 rows affected (0.0010 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.add( { _id: 999, foo: "snafu" } )
Query OK, 1 item affected (0.0057 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
{
  "_id": 999,
  "foo": "snafu"
}
2 documents in set (0.0006 sec)
MySQL localhost:33060+ ssl xtest JS > session.rollback()
Query OK, 0 rows affected (0.0051 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
1 document in set (0.0005 sec)
MySQL localhost:33060+ ssl xtest JS >
```



Transactions

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- Then we will use `find()` to check that that new document is in the collection

```
MySQL localhost:33060+ ssl xtest JS > session.beginTransaction()
Query OK, 0 rows affected (0.0016 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.add( { _id: 999, foo: "snafu" } )
Query OK, 1 item affected (0.0057 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
{
  "_id": 999,
  "foo": "snafu"
}
2 documents in set (0.0006 sec)
MySQL localhost:33060+ ssl xtest JS > session.rollback()
Query OK, 0 rows affected (0.0051 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
1 document in set (0.0005 sec)
MySQL localhost:33060+ ssl xtest JS >
```

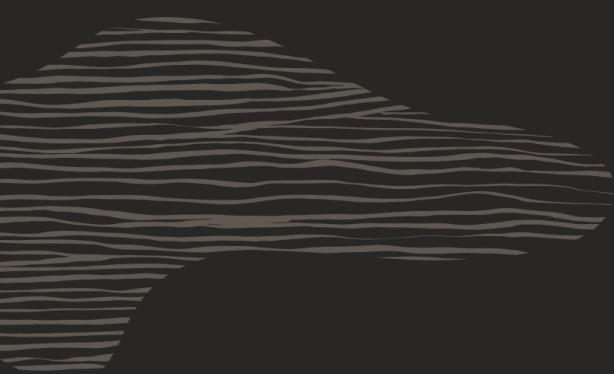


Transactions

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- Issuing a rollback removes the new document

```
MySQL localhost:33060+ ssl xtest JS > session.beginTransaction()
Query OK, 0 rows affected (0.0016 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.add( { _id: 999, foo: "snafu" } )
Query OK, 1 item affected (0.0057 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
{
  "_id": 999,
  "foo": "snafu"
}
2 documents in set (0.0006 sec)
MySQL localhost:33060+ ssl xtest JS > session.rollback()
Query OK, 0 rows affected (0.0051 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
1 document in set (0.0005 sec)
MySQL localhost:33060+ ssl xtest JS >
```



Transactions

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-
- Any guesses as to what session.commit() does?

```
MySQL localhost:33060+ ssl xtest JS > session.startTransaction()
Query OK, 0 rows affected (0.0016 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.add( { _id: 999, foo: "snafu" } )
Query OK, 1 item affected (0.0057 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
{
  "_id": 999,
  "foo": "snafu"
}
2 documents in set (0.0006 sec)
MySQL localhost:33060+ ssl xtest JS > session.rollback()
Query OK, 0 rows affected (0.0051 sec)
MySQL localhost:33060+ ssl xtest JS > db.a.find().fields('_id','foo')
{
  "_id": 12345,
  "foo": "bar"
}
1 document in set (0.0005 sec)
MySQL localhost:33060+ ssl xtest JS >
```



```
MySQL [localhost:33060+ ssl] world_x [JS] > db.countryinfo.find().fields(['Name', 'geography.Region', 'IndepYear']).limit(3)
```

```
{  
  "Name": "Aruba",  
  "IndepYear": null,  
  "geography.Region": "Caribbean"  
}  
{
```

```
  "Name": "Afghanistan",  
  "IndepYear": 1919,  
  "geography.Region": "Southern and Central Asia"  
}  
{
```

```
  "Name": "Angola",  
  "IndepYear": 1975,  
  "geography.Region": "Central Africa"  
}
```

```
3 documents in set (0.0005 sec)
```

```
MySQL [localhost:33060+ ssl] world_x [JS] > db.countryinfo.find("IndepYear > 1900").fields(['Name', 'geography.Region', 'IndepYear']).limit(3)
```

```
{  
  "Name": "Afghanistan",  
  "IndepYear": 1919,  
  "geography.Region": "Southern and Central Asia"  
}  
{
```

```
  "Name": "Angola",  
  "IndepYear": 1975,  
  "geography.Region": "Central Africa"  
}  
{
```

```
  "Name": "Albania",  
  "IndepYear": 1912,  
  "geography.Region": "Southern Europe"  
}
```

```
3 documents in set (0.0007 sec)
```

```
MySQL [localhost:33060+ ssl] world_x [JS] >
```

Find things with find()



```
MySQL [localhost:33060+ ssl] world_x [JS] > db.countryinfo.find("geography.Region = 'North America'").fields(['Name','geography.Region','InDepYear']).sort(['Name','InDepYear DESC'])  
{  
    "Name": "Bermuda",  
    "InDepYear": null,  
    "geography.Region": "North America"  
}  
{  
    "Name": "Canada",  
    "InDepYear": 1867,  
    "geography.Region": "North America"  
}  
{  
    "Name": "Greenland",  
    "InDepYear": null,  
    "geography.Region": "North America"  
}  
{  
    "Name": "Saint Pierre and Miquelon",  
    "InDepYear": null,  
    "geography.Region": "North America"  
}  
{  
    "Name": "United States",  
    "InDepYear": 1776,  
    "geography.Region": "North America"  
}  
5 documents in set (0.0012 sec)  
MySQL [localhost:33060+ ssl] world_x [JS] >
```

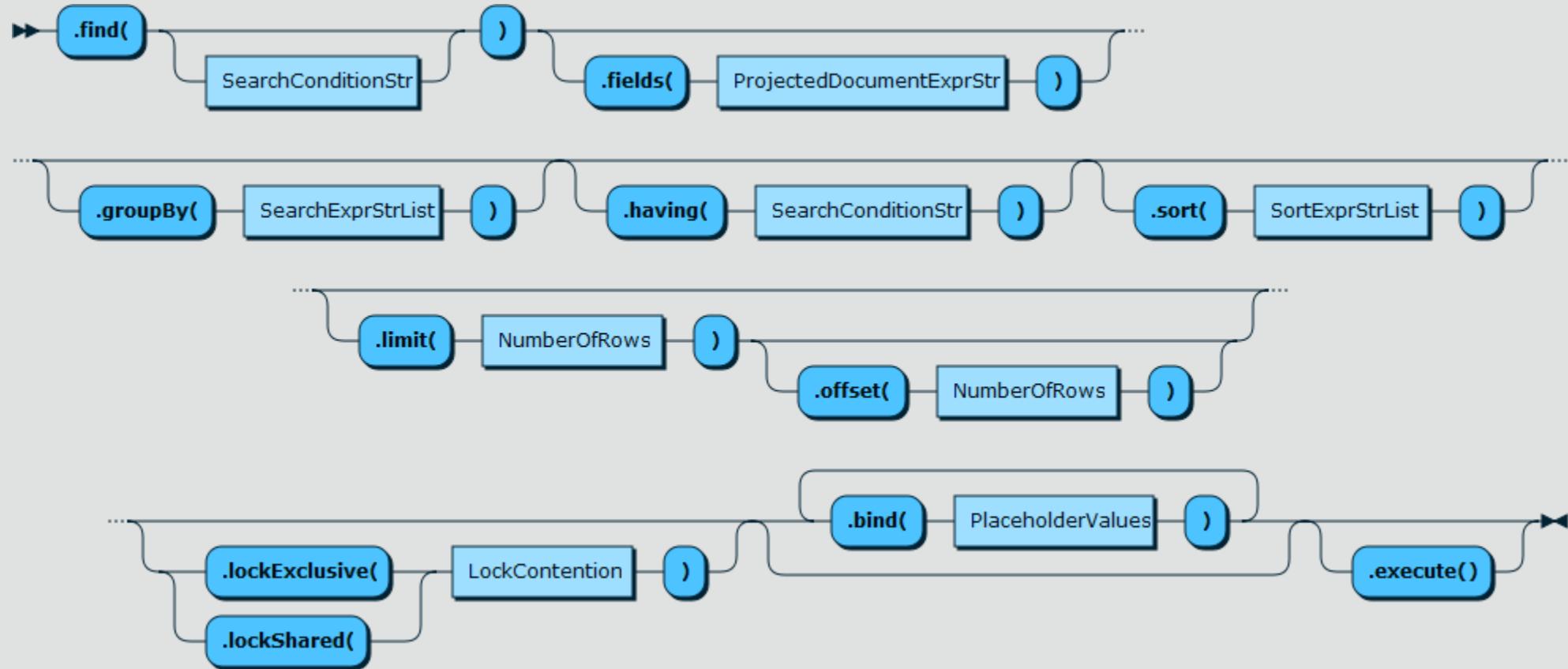
Find things with find()



What is the `_id`?

- The InnoDB used the `_id` field as a primary key for efficiency and, unlike other keys in the document, can not be changed. The document store will automatically assign a value but you can assign your own value but you need to make sure you do not duplicate these values or the server will complain. The `_id` number made of a 4 byte prefix, an 8 byte timestamp of the startup time of the server instance, and a 16 byte a per-instance automatically incremented integer value, which is hex encoded and has a range of 0 to $2^{64}-1$. The initial value of serial is set to the `auto_increment_offset` system variable, and the increment of the value is set by the `auto_increment_increment` system variable.
- Users of multi-primary Group Replication or InnoDB cluster can depend on inserts to the same table from different instances do not have conflicting primary key values; assuming that the instances have the `auto_increment_*` system variables configured properly.

EBNF's are in the workbook



Tables

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-
- Yes you can access your relational tables from the MySQL Document Store too!

```
MySQL [localhost:33060+ ssl] \u world_x
Default schema `world_x` accessed through db.
MySQL [localhost:33060+ ssl] world_x [JS] > db.getTables()
[
  <Table:city>,
  <Table:country>,
  <Table:countrylanguage>
]
MySQL [localhost:33060+ ssl] world_x [JS] > db.city.select().limit(1)
+-----+-----+-----+-----+
| ID | Name | CountryCode | District | Info
+-----+-----+-----+-----+
| 1 | Kabul | AFG         | Kabul     | {"Population": 1780000} |
+-----+-----+-----+-----+
1 row in set (0.0272 sec)
MySQL [localhost:33060+ ssl] world_x [JS] >
```



Tables

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-
- Where you can use db.getCollections() to find document collections, you can use db.getTables() to see the available tables!

```
MySQL [localhost:33060+ ssl] demo1 JS > \u world_x
Default schema `world_x` accessible through db.
MySQL [localhost:33060+ ssl] demo1 JS > db.getTables()
[
  <Table:city>,
  <Table:country>,
  <Table:countrylanguage>
]
MySQL [localhost:33060+ ssl] world_x JS > db.city.select().limit(1)
+-----+-----+-----+-----+
| ID | Name | CountryCode | District | Info
+-----+-----+-----+-----+
| 1 | Kabul | AFG         | Kabul     | {"Population": 1780000} |
+-----+-----+-----+-----+
1 row in set (0.0272 sec)
MySQL [localhost:33060+ ssl] world_x JS >
```

Tables

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- But you use `select()` instead of `find()` to query

```
MySQL [localhost:33060+ ssl] demo1 JS > \u world_x
Default schema `world_x` accessible through db.
MySQL [localhost:33060+ ssl] world_x JS > db.getTables()
[
  <Table:city>,
  <Table:country>,
  <Table:countrylanguage>
]
MySQL [localhost:33060+ ssl] JS > db.city.select().limit(1)
+----+----+----+----+
| ID | Name | CountryCode | District | Info
+----+----+----+----+
| 1  | Kabul | AFG        | Kabul    | {"Population": 1780000} |
+----+----+----+----+
1 row in set (0.0272 sec)
MySQL [localhost:33060+ ssl] world_x JS >
```

Exercise Final

Exercise Final

How many documents are in the world_x schema matching the CountryCode = 'BEL'?

```
db.city.select().where("CountryCode = 'BEL'")
```



Resources

- Using MySQL as a Document Store
<https://dev.mysql.com/doc/refman/8.0/en/document-store.html>
- Documentation on X Devapi
<https://dev.mysql.com/doc/>
- Connectors – C++, Java, JavaScript, .Net, Node.JS, Python, PHP
<https://dev.mysql.com/downloads/>
- Books

Introducing the MySQL Document Store – Dr. Charles Bell, MySQL & JSON – A Practical Programming Guide – Dave Stokes, MySQL Connector Python – Jesper Wisborg Krogh

Wrap up

Your reaction

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Thank You

Slides at slideshare.net/davidmstokes

Or <https://github.com/davidmstokes/preFOSDEM>

Safe Harbor

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