NoSQL + SQL = MySQL

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What If I Told You…

?

?

NoSQL + SQL

?

?

*…**is possible**?*


MySQL
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MySQL 8.0
The MySQL Document Store
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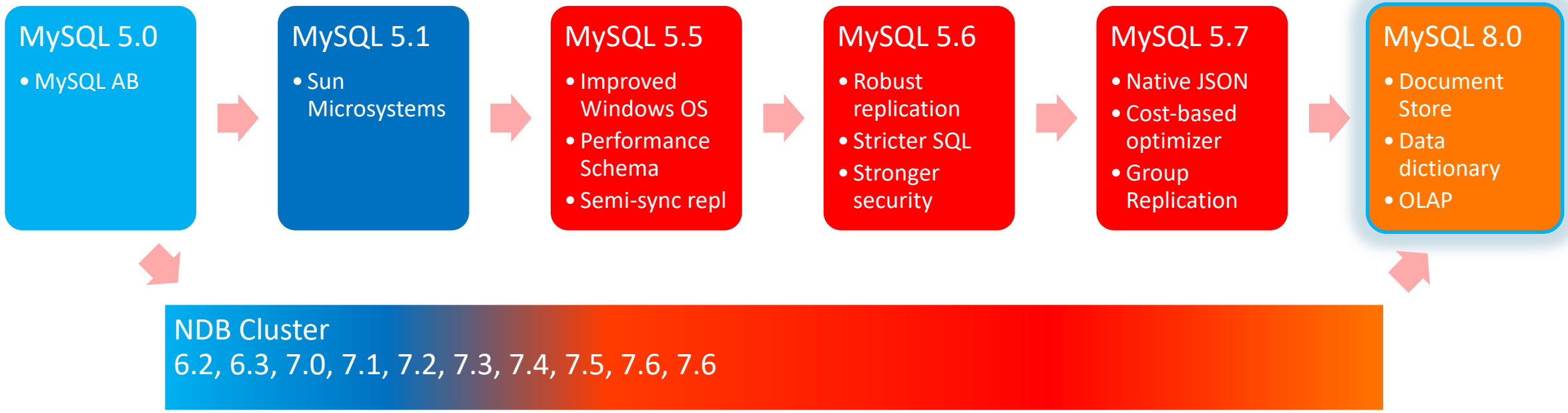
MySQL 8.0



MySQL Open Source (…Because It Makes Sense)

- GPLv2
  - Slightly modified for FOSS and OpenSSL
  - No extraneously restrictive licensing
- MySQL source code available on Github
  - MySQL Receives many contributions from community and partners
  - Development collaboration with some leading MySQL users
- Open Core business model
  - Additional tools and extensions available in Enterprise Edition
  - Server and client are GPL open source
    - This also helps to keep the ecosystem open source

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New! Alter Table - Instant Add Column

- Contribution from Tencent
  - Only a metadata change
  - No copying of data
  - Smaller final data size
  - Forward compatibility with old data file

Tencent Contribution

- `ALTER TABLE … ADD COLUMN col, ALGORITHM = INSTANT;`
- Supports DYNAMIC/COMPACT/REDUNDANT row formats

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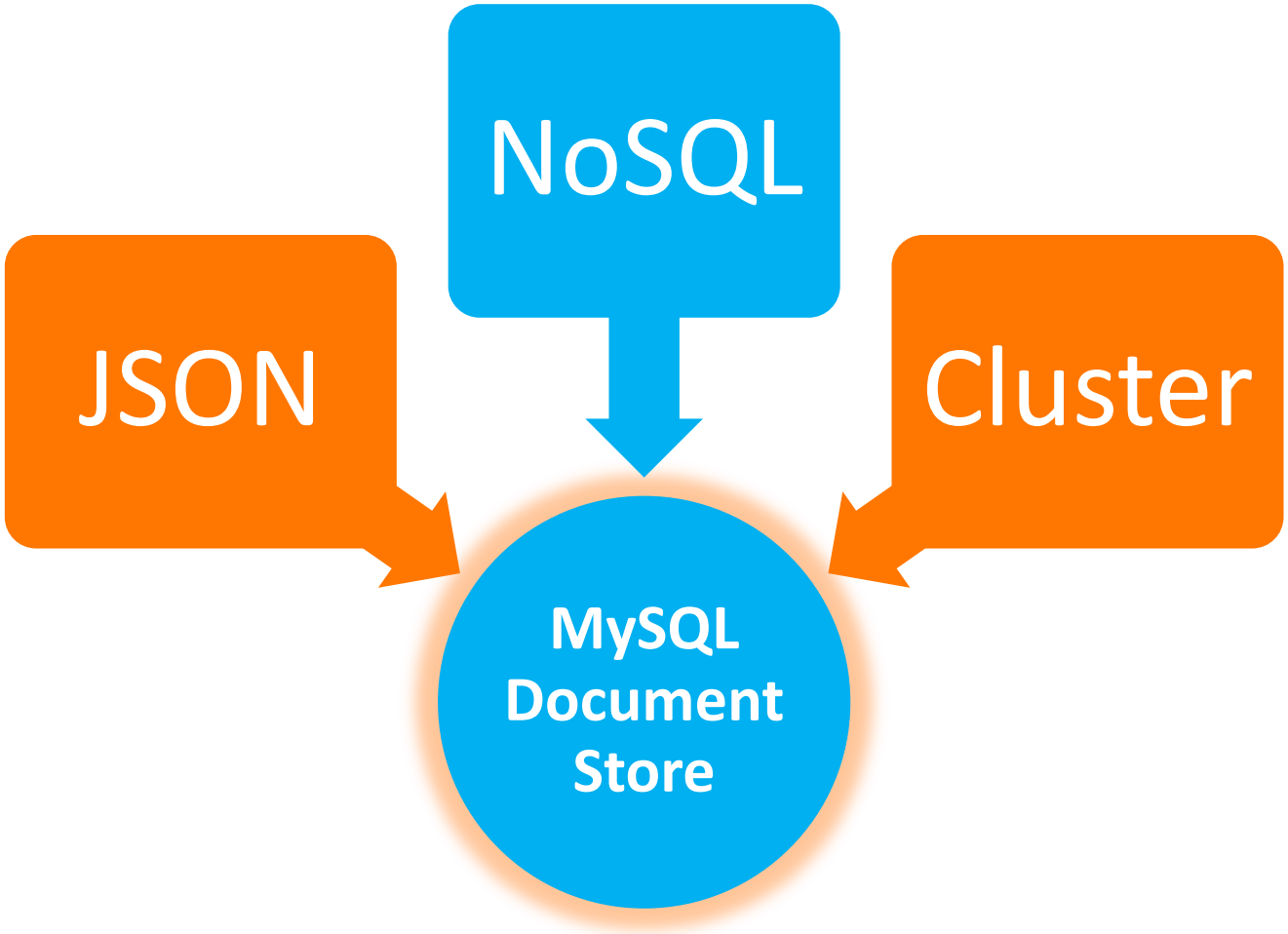
MySQL Document Store



Native JSON Data Type

```
CREATE TABLE employees (data JSON);
INSERT INTO employees VALUES ('{"id": 1, "name": "Jane"}');
INSERT INTO employees VALUES ('{"id": 2, "name": "Joe"}');

SELECT * FROM employees;
+----------------------------+
| data                       |
+----------------------------+
| {"id": 1, "name": "Jane"} |
| {"id": 2, "name": "Joe"}  |
+----------------------------+
2 rows in set (0,00 sec)
```

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JSON Data Type Specifications

- utf8mb4 default character set
- Optimized for read intensive workload
  - Parse and validation on insert only
- Dictionary:
  - Sorted objects' keys
  - Fast access to array cells by index
- Full type range supported:
  - Standard: numbers, string, bool, objects, arrays
  - Extended: date, time, timestamp, datetime, others
  - JSON Objects and Arrays, including embedded within each other

JSON Functions

JSON_ARRAY_APPEND()

JSON_ARRAY_INSERT()

JSON_ARRAY()

JSON_CONTAINS_PATH()

JSON_CONTAINS()

JSON_DEPTH()

JSON_EXTRACT()

JSON_INSERT()

JSON_KEYS()

JSON_LENGTH()

JSON_MERGE()

JSON_OBJECT()

JSON_QUOTE()

JSON_REMOVE()

JSON_REPLACE()

JSON_SEARCH()

JSON_SET()

JSON_TYPE()

JSON_UNQUOTE()

JSON_VALID()

MySQL 8.0:

JSON_TABLE()

JSON_PRETTY()

JSON_STORAGE_SIZE()

JSON_STORAGE_FREE()

JSON_ARRAYAGG()

JSON_OBJECTAGG()

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Shortcut Syntax

```
mysql> SELECT DISTINCT
       data->'$.zoning' AS Zoning
       FROM lots;
+---------------+
| Zoning        |
+---------------+
| "Commercial"  |
+---------------+
1 row in set (1.22 sec)
```

Special new syntax to access data inside JSON documents

Shortcut Syntax + Unquote

```
mysql> SELECT DISTINCT
       data->>'$.zoning' AS Zoning
       FROM lots;
+-------------+
| Zoning      |
+-------------+
| Commercial  |
+-------------+
1 row in set (1.22 sec)
```

Special new syntax to access data inside JSON documents + UNQUOTE

Indexing JSON Documents With Generated Columns

- Available as either VIRTUAL (default) or STORED:

```
ALTER TABLE features
ADD feature_type varchar(30)
AS (feature->>"$.type") VIRTUAL;
```

- Both types of computed columns permit for indexes to be added as "functional indexes"
  - Use **`ALTER TABLE… ADD INDEX(generated_column)`**
  - Use virtual generated columns to index JSON fields!

MySQL InnoDB Cluster

- Group-based replication
  - Group awareness
  - Conflict detection
  - Consensus 50% + 1
- Multi-primary mode
- Single primary mode
  - MySQL Router
- Automated failover
- Tooling for controlling cluster

"High Availability becomes a core first class feature of MySQL!"

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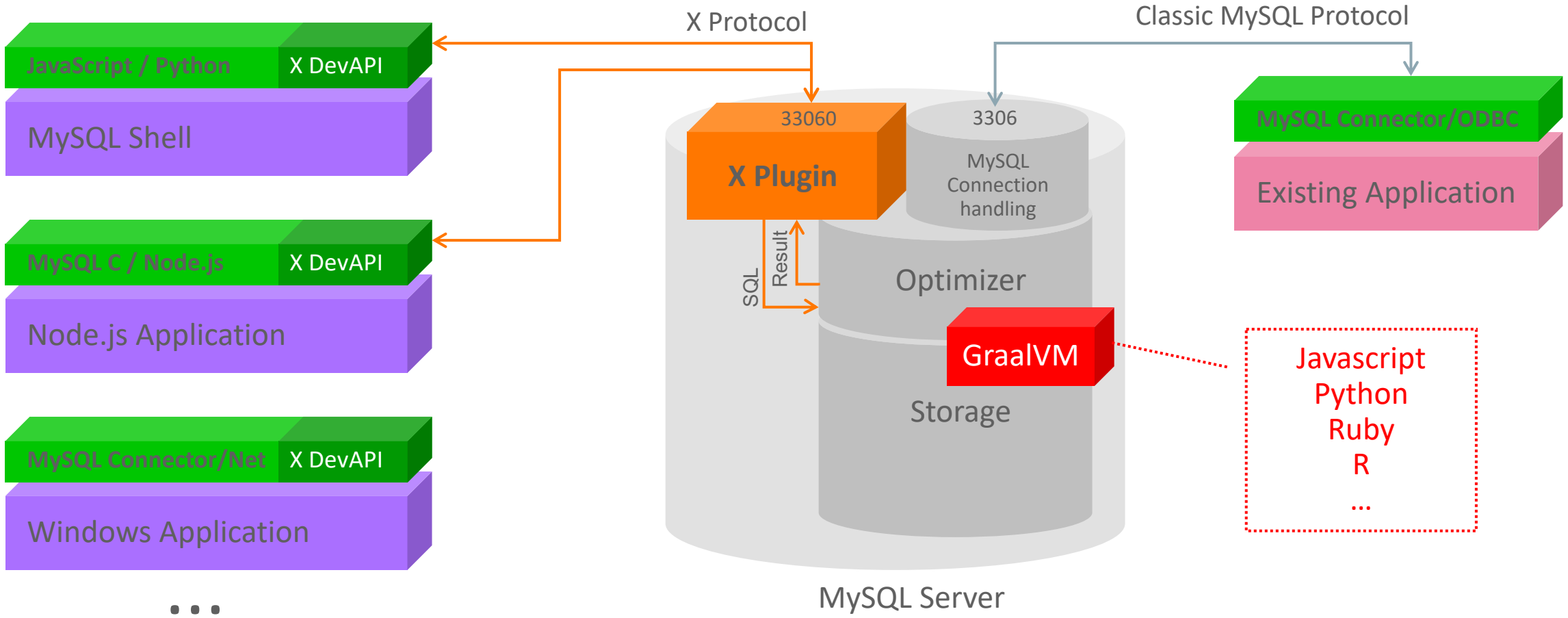
MySQL Has Native NoSQL



Node.JS Example

Native MySQL Programming

```
var schema = session.getSchema('mySchema');
var collection = schema.getCollection('myColl');
var query = "$.name == :name";
collection.find(query).bind('name','Alfredo').execute(function (doc) {
   console.log(doc);
 }).catch(function (err) {
   console.log(err.message);
   console.log(err.stack);
 });
```

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Tables or Collections?

- A collection is a table with 2+ columns:
  - Primary key: `_id`
  - JSON document: `doc`
    - The document's `_id` field can be supplied or be automatically generated by server as UUID
    - This field is also used to populate the primary key
- Can add extra columns and indexes to a collection
- SQL, NoSQL, tables, collections, all can be used simultaneously
- Operations compatible with replication

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NoSQL + SQL Demo
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NoSQL

- The demo uses MySQL Shell, which is part of the MySQL 8 distribution
- Create a collection in Javascript
  - View what is a collection in MySQL?
- Insert JSON documents
  - With and without *_id*
- Find JSON documents
- Update JSON documents
  - Confirm the changes
- Use SQL commands on JSON documents

Creating A Collection

Show the current database

JS> db

Change the current database

JS> \use demo

JS> db

Create a new collection

JS> var Collection=db.createCollection("architects")

JS> Collection

JS> \sql

SQL> SHOW CREATE TABLE `architects`;

Accessing An Existing Collection

Opening a collection

```
JS> var Collection=db.getCollection("architects")
JS> Collection
```

The help() Function

General help

JS> Collection.help()

In-depth help

JS> Collection.help("add")

Inserting Documents Into The Collection

The missing _*id* field is automatically generated.

```
JS> Collection.add({"name": "nicolas"})
JS> Collection.add({"name": "sastry"})
JS> Collection.add({"name": "dale"})
JS> Collection.add({"name": "michael"})
JS> Collection.add({"name": "kathy"})
JS> Collection.add({"name": "lee", "title": "manager"})
JS> Collection.add({"name": "benjamin"},{"name": "priscila"})
JS> \sql
SQL> SELECT * FROM `demo`.` architects`;
```

Inserting Documents Into The Collection (cont'd)

The existing _*id* field is used.

```
JS> Collection.add({"_id": "xoxoxoxo", "name": "tony"})
JS> \sql
SQL> SELECT * FROM `demo`.` architects`;
```

Retrieving Documents

All documents

```
JS> Collection.find()
```

With a condition

```
JS> Collection.find("name='Nicolas'")
```

With a bound variable

```
JS> var Value = "nicolas"
JS> Collection.find("name=:nm").bind("nm",Value).execute()
```

A single document

```
JS> var Document=Collection.getOne("xoxoxoxo")
JS> Document
```

Modifying A Document

Add a field

```
JS> Collection.modify("_id='xoxoxoxo'").set("weight",150).execute()
```

Transform the field into an object

```
JS> Collection.modify("_id='xoxoxoxo'").set("dimmensions",{weight:150}).execute()
JS> Collection.modify("_id='xoxoxoxo'").unset("weight").execute()
```

The document already retrieved doesn’t change

```
JS> Document
```

Deleting A Document

The remove() function

JS> Collection.help("remove")

JS> Collection.remove("_id='xoxoxoxo'")

Creating An Index

NoSQL

```
JS> Collection.createIndex("nosql_index",{"fields":[{"field":"$.name","type":"TEXT(20)"}],"type":"INDEX"})
JS> \sql
SQL> SHOW CREATE TABLE `architects`;
```

SQL

```
SQL> ALTER TABLE `architects` ADD COLUMN `name` TEXT GENERATED ALWAYS AS
      (JSON_UNQUOTE(JSON_EXTRACT(`doc`,_utf8mb4'$.name’))) VIRTUAL;
SQL> ALTER TABLE `architects` ADD INDEX `sql_index`(`name`(20));
```

Verifying Index Is Used

The explain command

```
SQL> EXPLAIN SELECT * FROM `architects`;
```

```
SQL> EXPLAIN SELECT * FROM `architects` WHERE `doc`->>'$.name' = 'nicolas’;
```

Bulk Importing Documents

Create collection (optional)

```
JS> var Restaurants = db.createCollection("restaurants")
```

Import documents

```
JS> utils.help("importJson")
JS> util.importJson("restaurants",{collection : "restaurants", convertBsonOid : true})
```

Search for documents

```
JS> Restaurants.find()
JS> Restaurants.find("name='Europa Cafe'")
JS> Restaurants.find("name='Europa Cafe' and address.street = 'Lexington Avenue'")
```

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Mixing SQL And JSON
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Exercise

- We are going to use the "restaurants" collection in SQL to find great restaurants near Times Square in New York City.
- The collection has geographical locations that we can index to limit the search of the scope to 0.5 miles around Times Square.
- We can also index the cuisine types for each restaurant so that we can choose based on our mood.
- The restaurants collection is a standard example collection from MongoDB (thanks Mongo!).

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Adding Indexes To The Collection

Create a Spatial index (can also be done in NoSQL)

```
SQL> ALTER TABLE `demo`.`restaurants`
        ADD COLUMN `location` GEOMETRY
        GENERATED ALWAYS AS (POINT(`doc`->>'$.address.coord[0]',`doc`->>'$.address.coord[1]'))
        STORED NOT NULL SRID 0;
SQL> ALTER TABLE `demo`.`restaurants` ADD SPATIAL INDEX(`location`);
```

Create a full-text search index

```
SQL> ALTER TABLE `demo`.`restaurants` ADD COLUMN `Cuisine` TEXT
        GENERATED ALWAYS AS (`doc`->>'$.cuisine') STORED;
SQL> ALTER TABLE `demo`.`restaurants` ADD FULLTEXT INDEX(`Cuisine`);
```

Best Italian And Chinese Restaurants Near Times Square

```
WITH `CTE` AS
(SELECT `doc`->>'$.name' AS `Restaurant`,
        `Cuisine`,
        (SELECT AVG(`Grades`.`Score`) AS `Score`
         FROM JSON_TABLE(`doc`,'$.grades[*]' COLUMNS (`Score` INT PATH '$.score')) AS
           `Grades`) AS `Average`,
        ST_Distance_Sphere(`location`,@TimesSq) AS `Distance`
  FROM `demo`.`restaurants`
  WHERE ST_Contains(ST_MakeEnvelope(POINT(ST_X(@TimesSq) + @Dist,ST_Y(@TimesSq) + @Dist),
                                    POINT(ST_X(@TimesSq) - @Dist,ST_Y(@TimesSq) - @Dist)),
                                    `location`)
  AND MATCH(`Cuisine`) AGAINST('Italian Chinese' IN BOOLEAN MODE)
  ORDER BY `Distance`) ...
```

Best Italian And Chinese Restaurants Near Times Square

```
…
SELECT
  `Restaurant`,
  `Cuisine`,
  RANK() OVER (PARTITION BY `Cuisine` ORDER BY `Average`) AS `Rank`,
  `Distance`
FROM
  `CTE`
ORDER BY
  `Rank`, `Average` DESC
LIMIT 10;
```


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Thank You!
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