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MySQL Shell for Database Engineers

The Best MySQL Administration Tool

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OCI 2023 Foundations OCA

OCI 2022 Architect OCA

OCI 2020 Architect OCA

OCI 2018 Architect OCA

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Context

MySQL turned 28 years old this year!

It's a relational database:

- SQL
- Has a command-line SQL client: mysql

But MySQL isn't just relational databases...

Meet MySQL Shell

Modern, new command-line client for MySQL

Written from scratch, supporting:

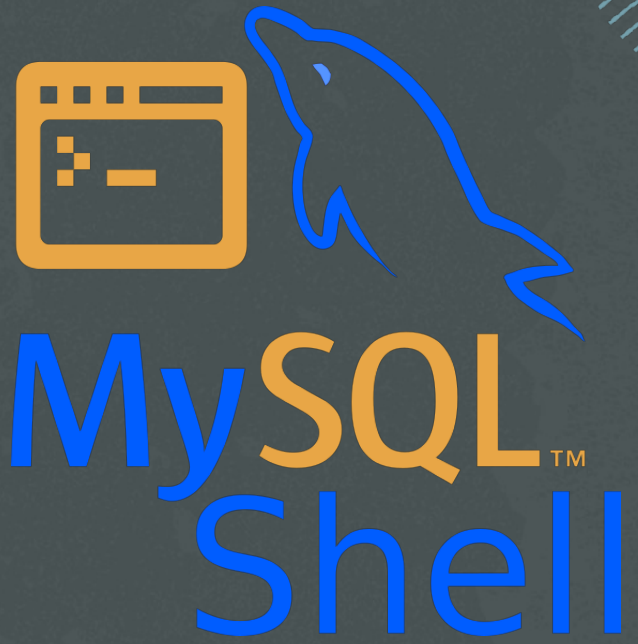
- MySQL Document Store (NoSQL, X DevAPI)
- JSON Documents / SQL Tables
- SQL, Python and JavaScript
- Fully customizable

There’s much more in Shell than meets the eye!

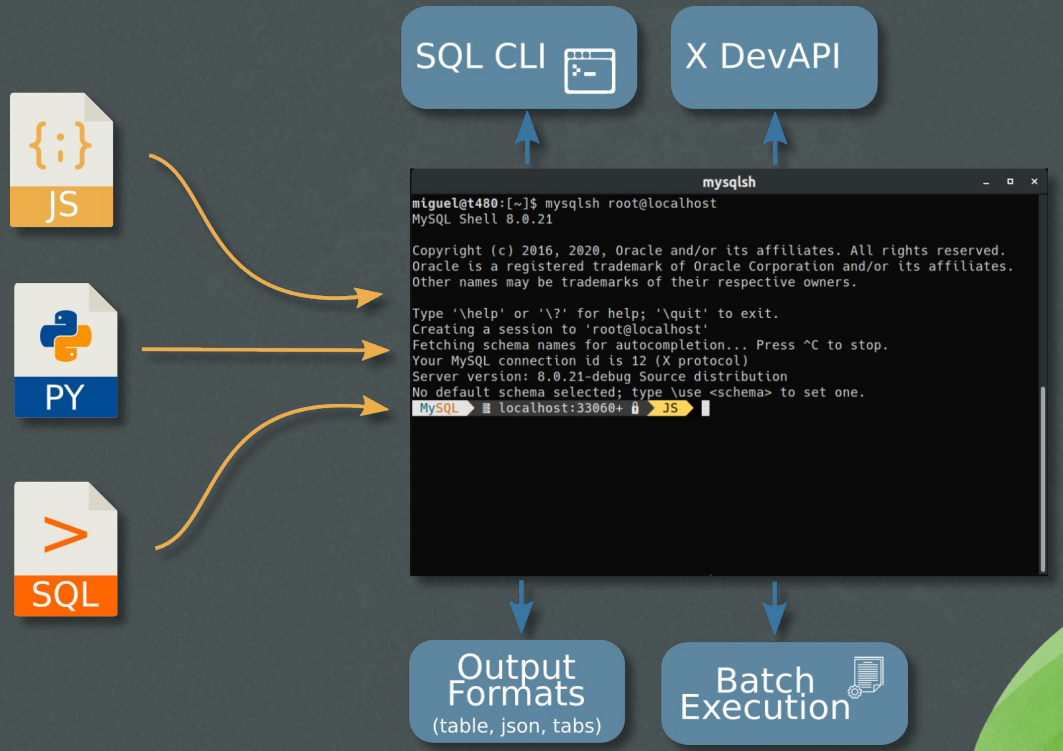
MySQL Shell

A DBA and Developer Toolbox:

- SQL, JavaScript and Python support
- Auto-completion
- Command history
- Integrated built-in help system
- Customizable prompts / colors
- APIs and Utilities built-in
- Extensible
- Open-source!



MySQL Shell Overview



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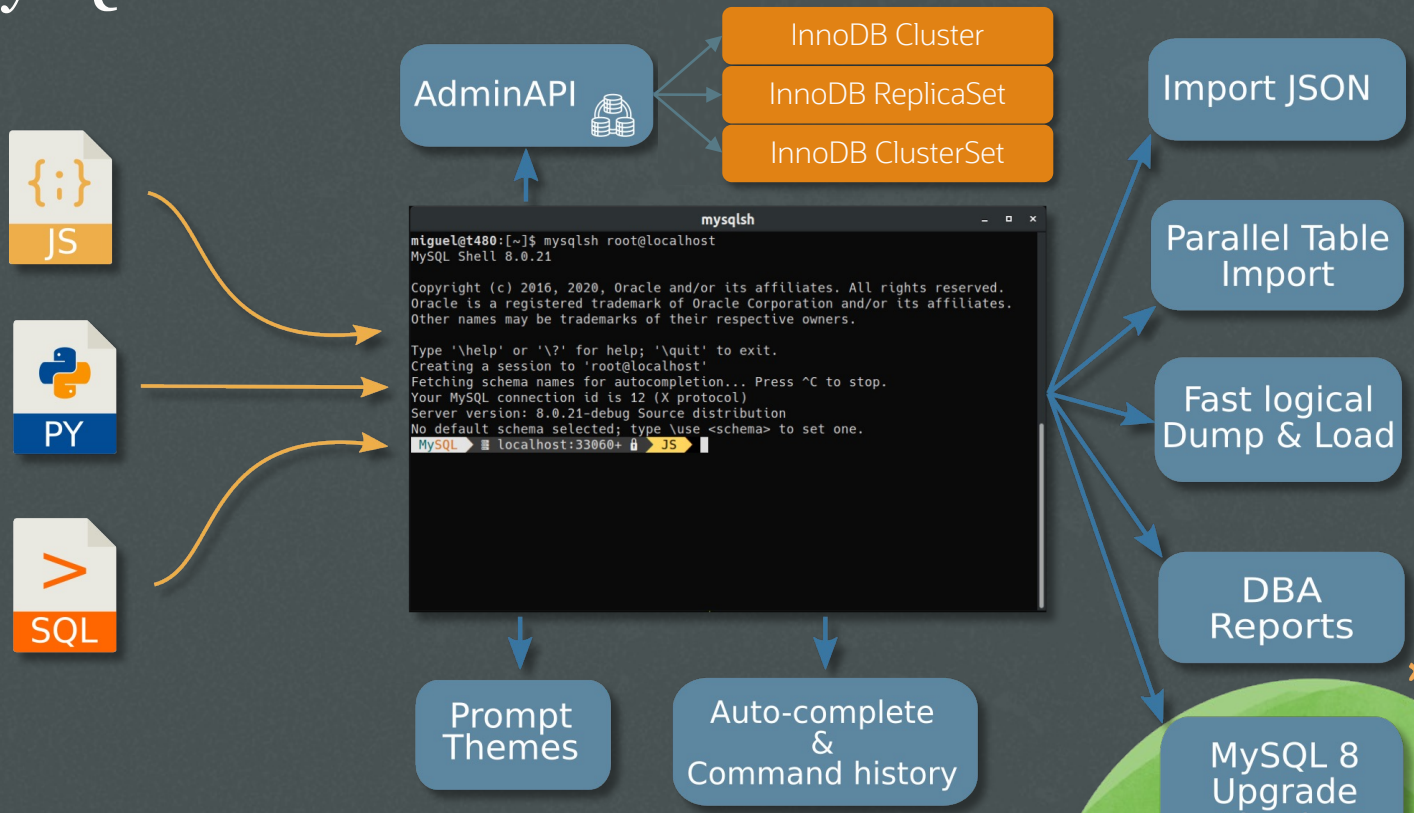

The MySQL Toolbox

MySQL Protocols

- `mysql`
- `mysqlx`

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ShellAPI

- OS utilities
- General purpose functions
- Create Reports
- Create Plugins
- Manage Credentials

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AdminAPI

- InnoDB Cluster
- InnoDB ReplicaSet
- InnoDB ClusterSet
- Sandboxes

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AdminAPI

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Utilities

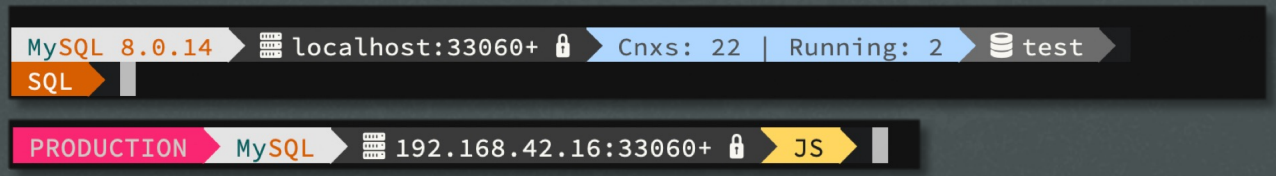
- Upgrade checker
- JSON import
- Parallel import table
- Instance and Schema dump
- Dump loading

Multi-language Support

- SQL
- JavaScript
  - Full JS engine (V8)
  - All core language features
- Python
  - 3.6+

Pleasant experience

- Auto-complete
- Customizable prompt with colors and state information



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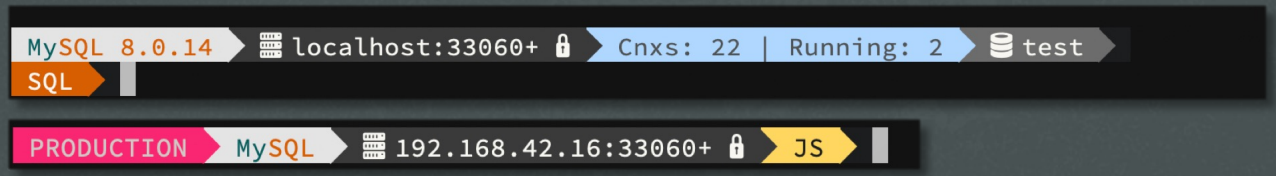
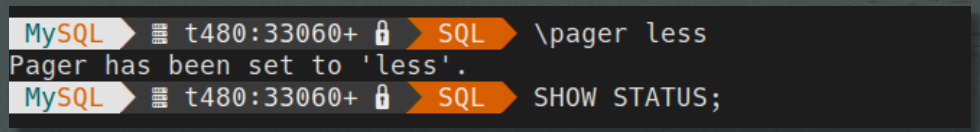
- Customizable prompt with colors and state information



- Command history; Pager: more/ less



Pleasant experience

- Integrated built-in Help system
- Accessible via:
  - `\? <topic>`
  - `\help <topic>`
- All functionality available

```
MySQL  SQL  \help \connect
NAME
      \connect - Connects the shell to a MySQL server and assigns the global
      session.

SYNTAX
      \connect [<TYPE>] <URI>
      \c [<TYPE>] <URI>

DESCRIPTION
      TYPE is an optional parameter to specify the session type. Accepts the
      following values:

      - --mc, --mysql: create a classic MySQL protocol session (default port
        3306)
      - --mx, --mysqlx: create an X protocol session (default port 33060)

      If TYPE is omitted, automatic protocol detection is done, unless the
      protocol is given in the URI.

      URI format is: [user[:password]@]hostname[:port]

EXAMPLE
      \connect --mx root@localhost
            Creates a global session using the X protocol to the indicated URI.
```

Built-in APIs

- APIs for managing and interacting with MySQL
- All APIs available in JavaScript and Python:
  - `X DevAPI`
  - `ShellAPI`
  - `AdminAPI`
- Flexibility and power of choice

Database APIs

Classic protocol

```
// Print a welcome message
println('Create a local MySQL account with special privileges.');

// Prompt for the username if not passed by argument
if (sys.argv[1] == undefined) {
    username = shell.prompt('Please enter the username for the account: ');
} else {
    username = sys.argv[1];
}

// Prompt for the password
pwd = shell.prompt('Please enter a password for the account ' + username + ': ',
{type: 'password'});
```

Database APIs

Classic protocol

```
// List of required grants
var grantsList = [
    'USAGE ON *.*',
    'SELECT, INSERT, UPDATE, DELETE, CREATE TEMPORARY TABLES ON world_x.*'
];

try {
    // Create the account
    session.runSql('CREATE USER ?@\'localhost\' IDENTIFIED BY ?', [username, pwd]);
    for (var grant in grantsList) {
        session.runSql('GRANT ' + grantsList[grant] + 'TO   ?@\'localhost\'',
                       [username])
    }
} catch (err) { (...) }
```

Multiple MySQL connections

- Work with multiple MySQL sessions simultaneously
- Using ShellAPI and/or X DevAPI

Example in Python:

```
session1 = mysql.get_session("admin@t480:3330")
session2 = mysql.get_session("root@localhost:3306")

session1.run_sql("SELECT @@hostname, @@port;")

result = session2.run_sql("SELECT * FROM performance_schema.global_status;")
row = result.fetch_all()
print(row[10])
```

Utilities

- DBA focused:
  - Upgrade Checker
  - JSON import
  - Parallel table import
  - Dump & load
  - Session inspector
- Exposed on the ShellAPI util module

Upgrade Checker

- Check for compatibility issues for upgrading to MySQL 8
  - **5.7 → 8.0+** (current Shell version)
- Warns about required actions:
  - Obsolete/conflicting settings
  - Schema properties requiring changes
- Can check .cnf files

```
// Available through the util object
mysqlsh-js> util.checkForServerUpgrade("root@localhost");
```

Upgrade Checker

```
MySQL  t480:3361  JS  util.checkForServerUpgrade()
The MySQL server at t480:3361, version 5.7.26 - MySQL Community Server (GPL),
will now be checked for compatibility issues for upgrade to MySQL 8.0.22...

1) Usage of old temporal type
  No issues found

2) Usage of db objects with names conflicting with new reserved keywords
  No issues found

3) Usage of utf8mb3 charset
  No issues found

4) Table names in the mysql schema conflicting with new tables in 8.0
  No issues found

5) Partitioned tables using engines with non native partitioning
  No issues found

6) Foreign key constraint names longer than 64 characters
```

API Command-line Integration

- **All** APIs are available on the command-line
- Accessible using the special delimiter character `--`
- Arguments follow a syntax suitable for command-line use:

```
mysqlsh [shell options] -- <object> <command>
[command options]
```

Example:

```
mysqlsh admin@t480 -- cluster status --extended=1
```

API Command-line Integration

- Integrating Shell's Upgrade Checker with Puppet:

```
service { 'mysql': ensure => latest,
  enable => true,
  require => Package ['mysql-server-community'], before => Exec
  ['upgrade checker']
}
exec { "upgrade checker":
      command => "mysqlsh -- util check-for-server-upgrade --user=root
--    host=localhost --port=33100 --password='mypassword'"
      require => service["mysql"]
}
```

JSON Import

- Import JSON documents into a collection or relational table
- Removes the need to use multiple `INSERT` statements or write scripts
- Supports BSON data types

```
// Available through the util object
mysqlsh-js> util.importJson("/home/miguel/banks.json", {schema: "docstore",
collection: "banks"})
```

```
// Very handy to be used with the API command-line integration
$ mysqlsh admin@localhost/docstore -- util import-json banks.json --collection=banks
```

Dump & Load

- Powerful utilities to make it easy to do logical dumps and load of:
  - A whole database instance
  - A set of schemas
- Focus on ease of use:

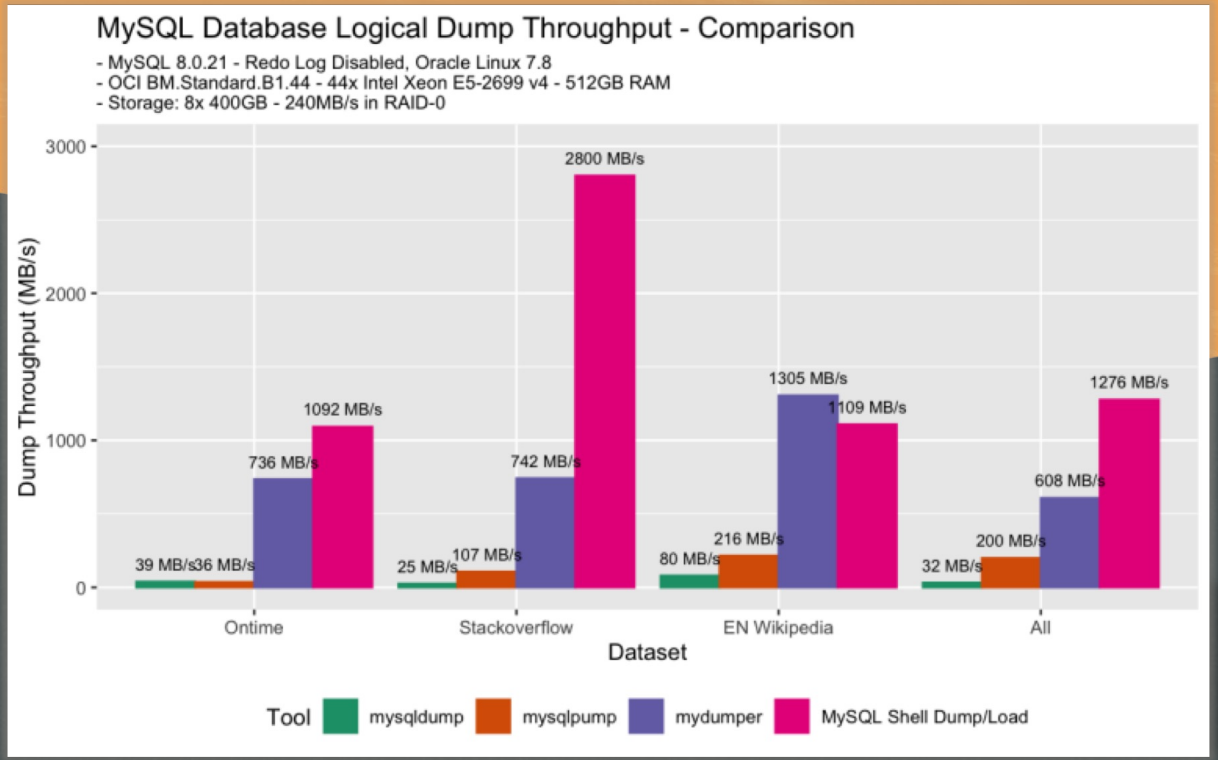
```
// Dump and entire database instance, including users
util.dumpInstance(...)

// Dump a set of schemas
util.dumpSchemas(...)

// Load a dump into a target database
util.loadDump(...)

// Streaming a dump into a target database
util.copyInstance(...)
```

Dump & Load

- Focus on performance:
  - Multi-threaded dump and load
  - Concurrent execution of dump and load
  - Built-in compression (zstd & gzip)

- Focus on integration:
  - Dump & Load straight to/from OCI Object Storage/Amazon S3
  - Compatibility modes for importing into OCI MySQL Database Service

Dump & Load



Replication & High Availability

- MySQL offered individual components to achieve Highly Available setups
  - Leaving it up to the user to set-up the architectures…

1. Provisioning, restoring backups
2. User management
3. Replication configuration
4. Deployment of client proxies
5. Manually changing topologies (or rely on external tools)
6. Use additional monitoring tools

A lot of work for DBA's and SysAdmins, who spend their time automating

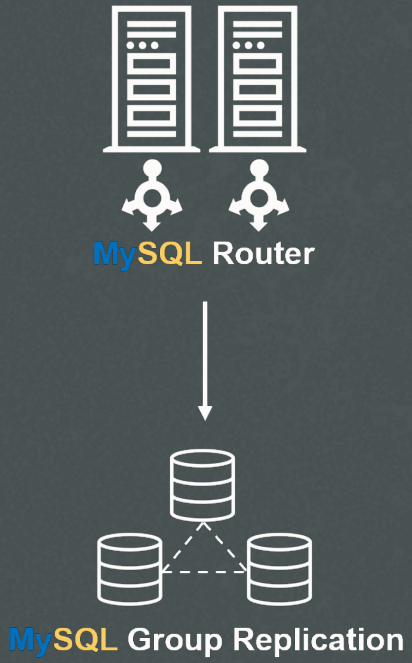
AdminAPI

- Setup and Management of InnoDB Cluster / ReplicaSet / ClusterSet
- Hides the complexity of:
  - Configuration
  - Provisioning
  - Orchestration
- Simple and straight-forward
- Doesn’t require MySQL expertise
- Flexible, powerful and secure

MySQL Administration

MySQL InnoDB Cluster

MySQL Shell

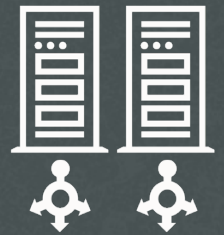


- MySQL Group Replication
- MySQL Shell
- MySQL Router

Complete HA Solution!

MySQL InnoDB ReplicaSet

MySQL Shell



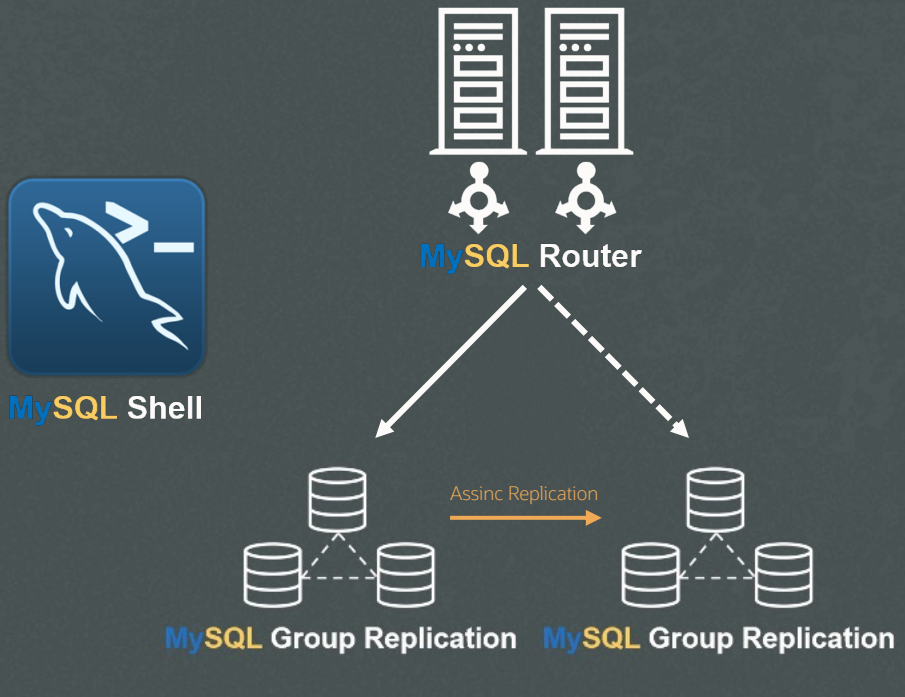
MySQL Router

MySQL Replication

- MySQL Replication
- MySQL Shell
- MySQL Router

Simple but complete Replication Solution!

MySQL InnoDB ClusterSet



- MySQL Replication
- MySQL Shell
- MySQL Router

Simple but complete HA + DR Solution!

AdminAPI

Creating a Cluster

```
// Configure Instances for Cluster usage
mysqlsh-js> dba.configureInstance("root@mysql1", {clusterAdmin: "admin"})
(...)

// Create the Cluster
mysqlsh-js> \c admin@mysql1
mysqlsh-js> cluster = dba.createCluster("myCluster")

// Add Instances to the Cluster
mysqlsh-js> cluster.addInstance("mysql2")
```

Couldn’t be easier!

Powerful solutions supported by Shell’s ease of use

ShellAPI

- General purpose functions and properties
- OS utilities
- Credential Manager
- Extend MySQL Shell
  - Reports
  - Plugins


Credential Manager

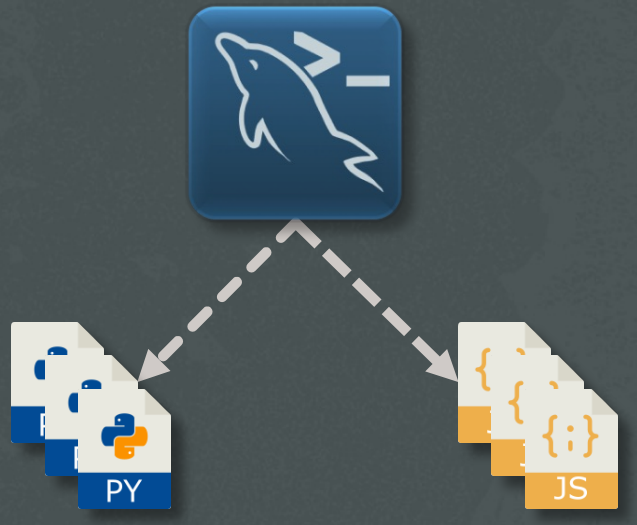
- Store passwords using a secret store or keychain
- Greatly improves usability and saves time
- Built-in support for:
  - MySQL login-path (`mysql_config_editor`)
  - macOS keychain
  - Windows Credentials Management API

Credential Manager

```
// List available Secret Stores
mysqlsh-js> shell.listCredentialHelpers();
[
    "keychain",
    "login-path"
]
// List stored credentials
mysqlsh-js> shell.listCredentials();
[
    "miguel@t480:3306",
    "admin@10.0.2.15:3306",
    "customer@10.0.2.15:3306"
]
```

Extend MySQL Shell

- Extend Shell functionality through plugins
- Create new global reports or extensions objects
- Available in JavaScript or Python
- All Shell APIs available
- Automatically loaded at start-up



Extend MySQL Shell

- API to register extensions:

```
// Register a user-defined report
shell.registerReport([name, type, report[, description]);

// Create an extension object
shell.createExtensionObject();

// Add a new member into an extension object
shell.addExtensionObjectMember([object, name, member[, definition]);

// Register an extension object as a Shell global object
shell.registerGlobal(name, object[, definition]);
```

Create a Report to get the uptime

.mysqlsh/init.d/uptime.py:0

```
def uptime(session):
    stmt = "SELECT TIME_FORMAT(SEC_TO_TIME(VARIABLE_VALUE ), '%Hh %im %ss') AS Uptime
FROM performance_schema.global_status WHERE VARIABLE_VALUE='Uptime';"

    result = session.run_sql(stmt)
    report = [result.get_column_names()]

    for row in result.fetch_all():
        report.append(list(row))

    return {'report': report}
```

Create a Report to get the uptime

.mysqlsh/init.d/uptime.py:13

```
shell.register_report(
    'uptime',
    'list',
    uptime,
    {
        'brief': 'Shows Server Uptime.',
        'details': ['You need the SELECT privileges on performance_schema.*'],
        'arg': '0'
    }
)
```

Create a Report to get the uptime

```
MySQL  localhost:3361  JS  \? shell.reports.uptime
NAME
      uptime - Shows Server Uptime.

SYNTAX
      shell.reports.uptime(session)

WHERE
      session: Object. A Session object to be used to execute the report.

DESCRIPTION
      This is a 'list' type report.

      You need the SELECT privilege on performance_schema.global_status.

      The session parameter must be any of ClassicSession, Session.
MySQL  localhost:3361  JS  \show uptime
+-------------+
| Uptime      |
+-------------+
| 29h 00m 07s |
+-------------+
```

Create a Plugin for system information

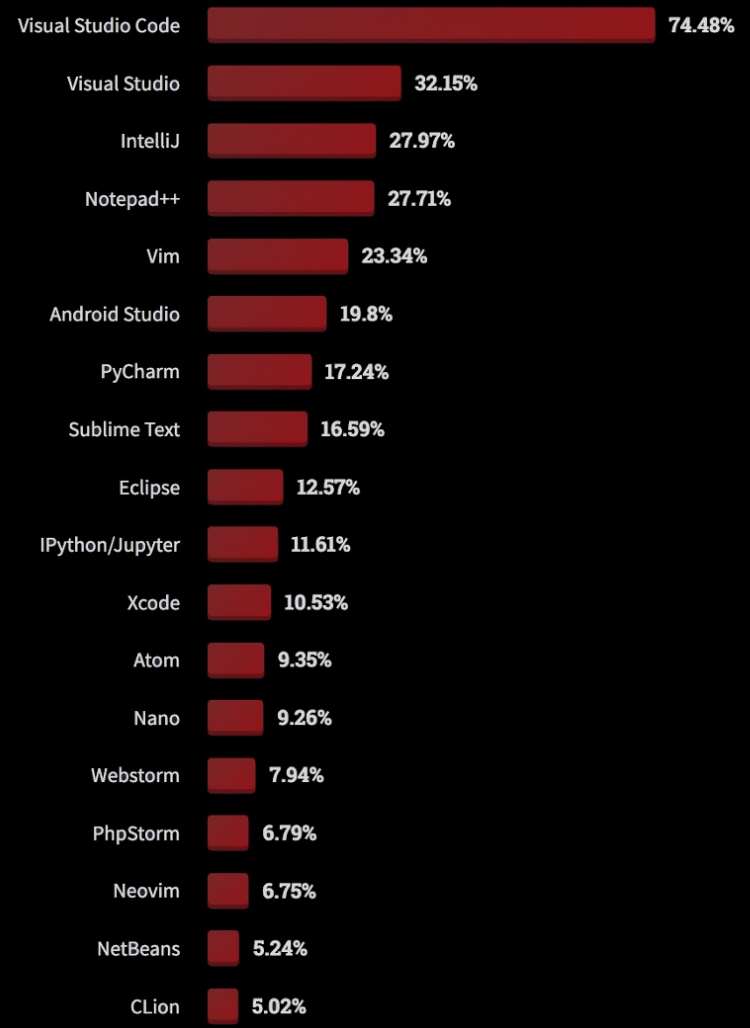
.mysqlsh/plugins/ext/system_info/init.py

```
from mysqlsh.plugin_manager import plugin, plugin_function
@plugin
class system_info:
    """
    System Information

    A collection of tools to gather system information.
    """
@plugin_function("system_info.get_public_key")
def get_public_key(session=None, verbose=False):
    """
    Get RSA Public Key of (...)
```

Create a Plugin for system information

```
MySQL  localhost:3320  Py  \? system_info
NAME
      system_info - System Information

DESCRIPTION
      A collection of tools to gather system information.

FUNCTIONS
      get_public_key([session][, verbose])
            Get RSA Public Key of the caching_sha2_password auth plugin

      help([member])
            Provides help about this object and it's members

      uptime([session][, verbose])
            Get the server uptime
MySQL  localhost:3320  Py  system_info.get_public_key(session, True)
-->  SELECT VARIABLE_VALUE FROM performance_schema.global_status WHERE VARIABLE_NAME = 'Caching_sha2_password_rsa_public_key';
-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAywoRH7uBIlAyiI31gWGj
dqq34w6LqADgZFcP2m+F9I1TqUfBGWGVAMAzXM8IvTmgq+wvzkFHrvYtcZWEmdIU
0fVQNGd9eFcltqezdjE5bJUCV3ohW5T/Z4NY0Rs1RRWKJGj3krdXMgVCj+YOkGo0
rqZ/s2VYraRP0DLZPqREWxajgYrqyEa9SZN++YVb1CU/cXoIDCbiGvJRd5NwyxSM
1Wb4VCUXZrpvvNAluaJD+WIOPYQUYta6FnG01/Jm6nMOXk+MDnni4C0VR6x7qQrO
i7k0avCFvWD9MJO5e8PrFYJtY1AW80U6ciR3Wka6KIkkuS14bLmg9CJa/wzEzuup
7QIDAQAB
-----END PUBLIC KEY-----
```

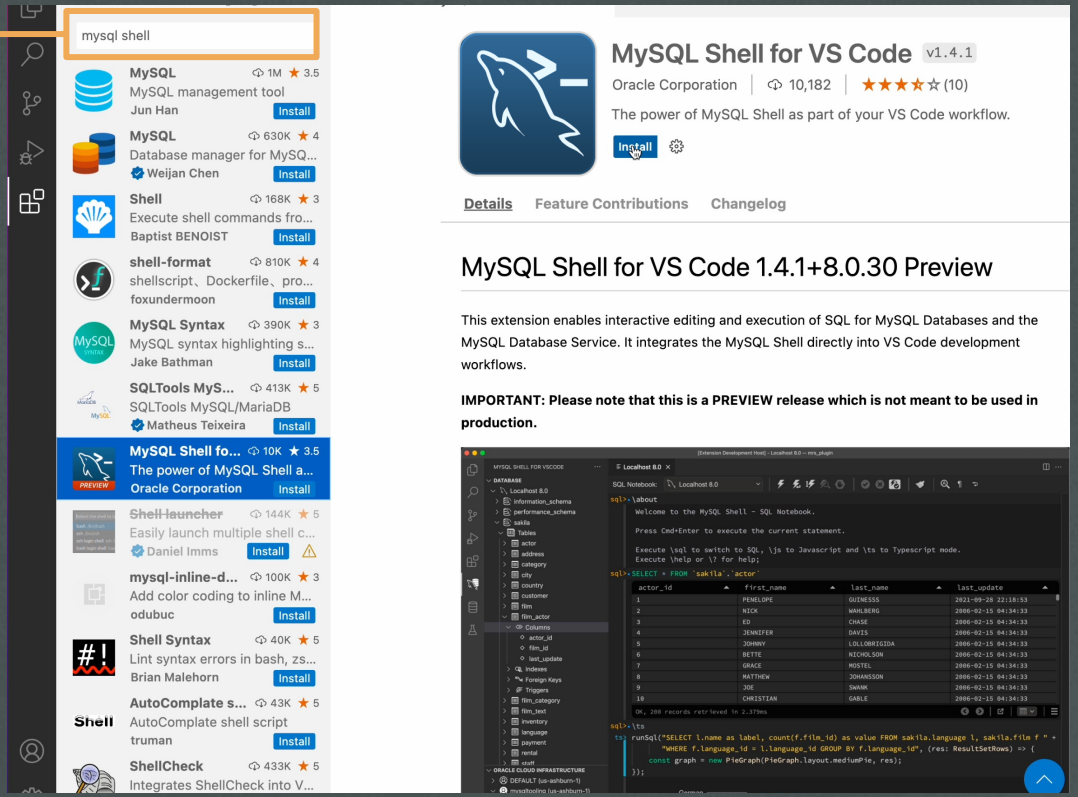
MySQL Shell for VSCode



"In the Stack Overflow 2022 Developer Survey, Visual Studio Code was ranked the most popular developer environment tool, with 74% of 71,000 respondents reporting that they use it."

Extension Installation

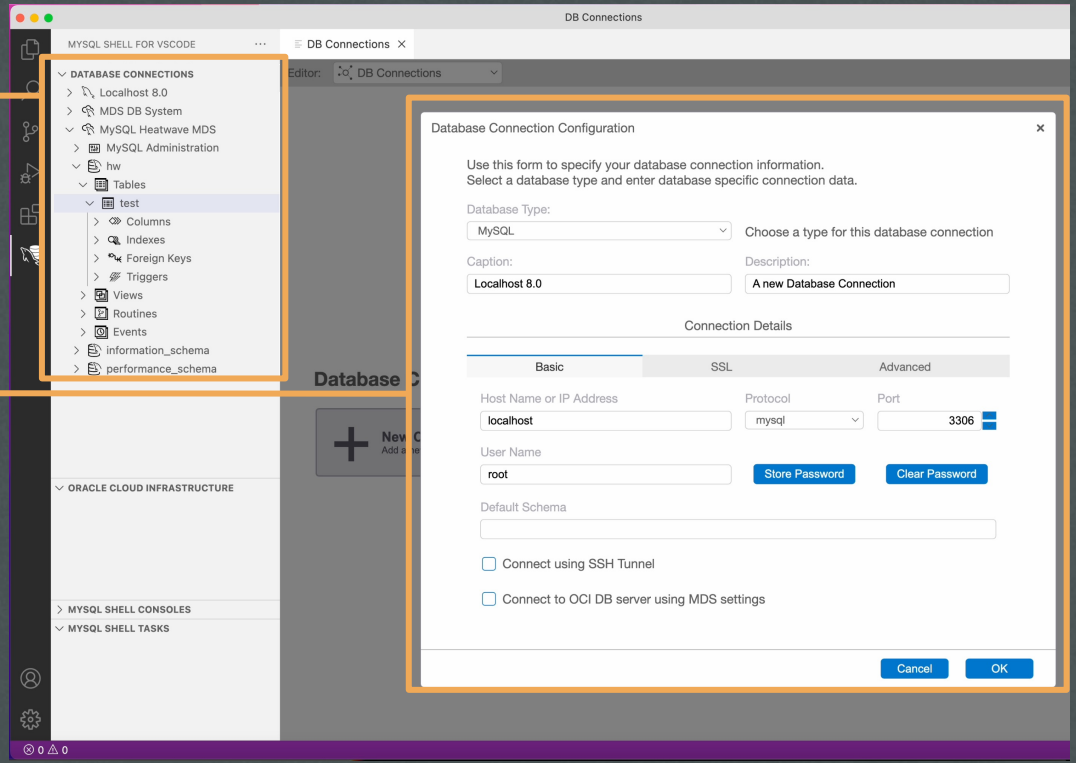
Install
MySQL Shell for VSCode
directly in Marketplace



Adding DB Connections

Database Editor
Connections View

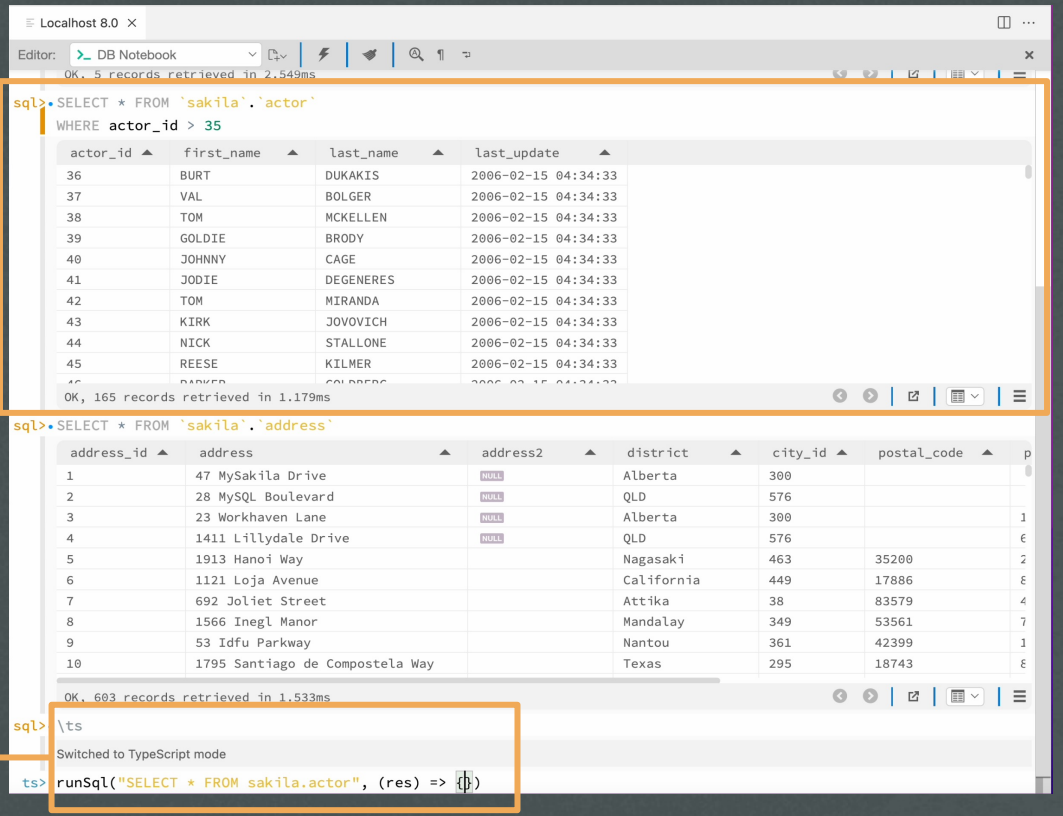
Create Remote
MySQL Connections



SQL Notebook Interface

Write, Execute, Edit,
Execute within Notebook

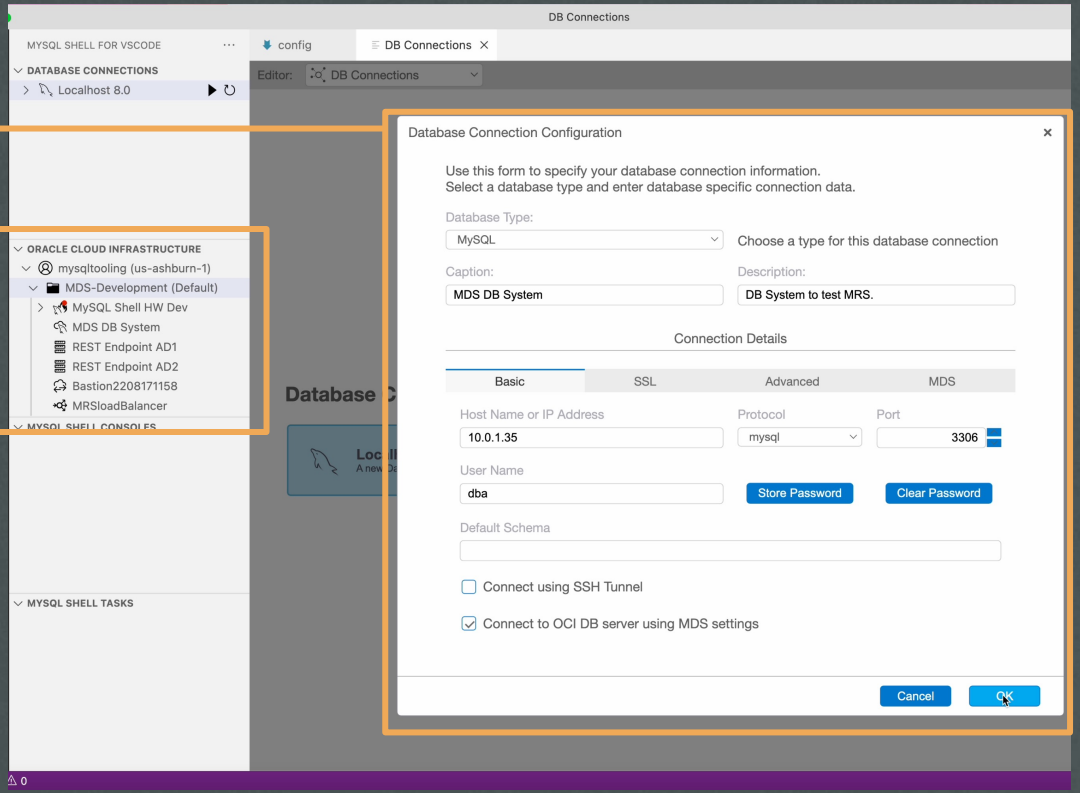
TypeScript
(JS & py Support)



OCI MySQL HeatWave

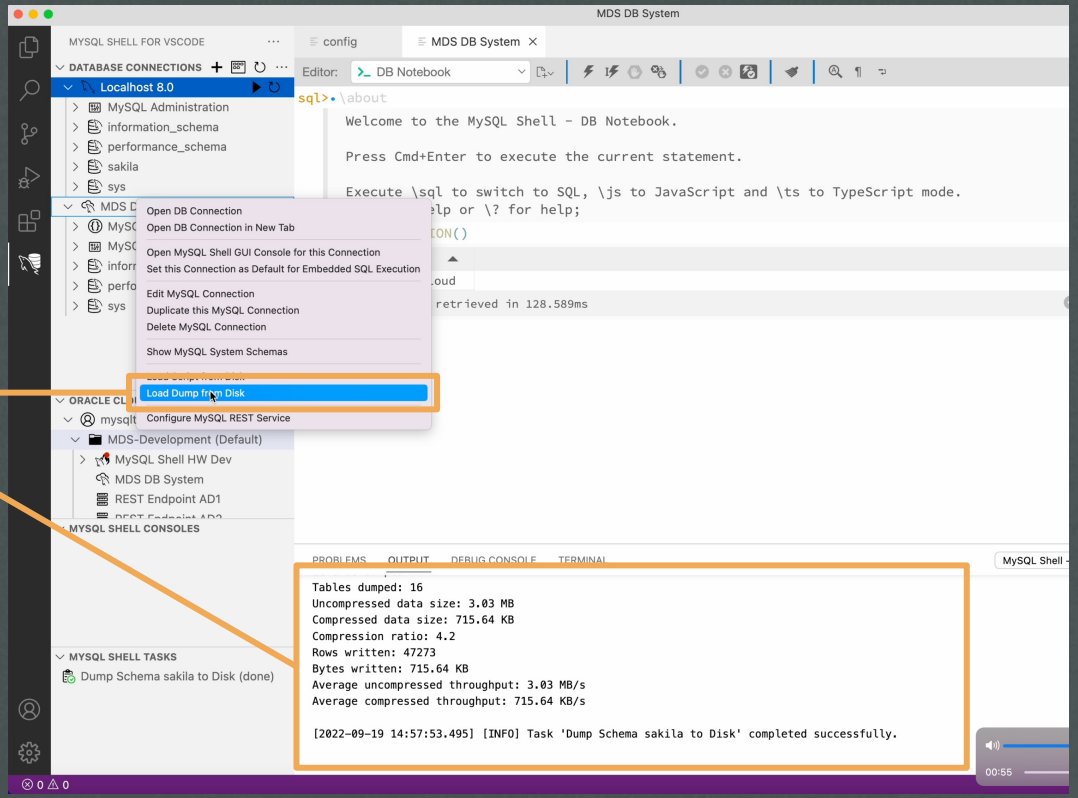
Connect Directly to DBSystem via OCI Bastion Service

Access OCI MySQL Infrastructure



Lift and Shift

MySQL Shell Dump & Load
Within VS Code



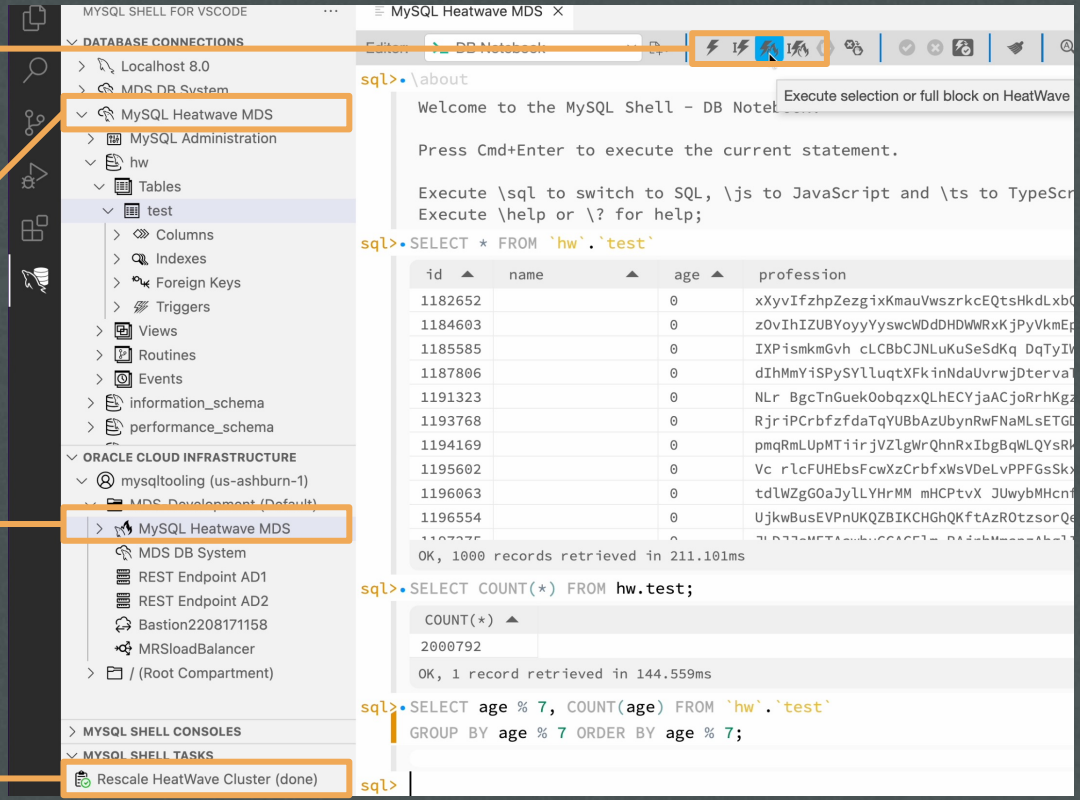
Integration MySQL HeatWave for OLAP

Execute Directly with HeatWave

Connect Directly from Customers On-Premise Network via Bastion

MDS/Heatwave Management

HeatWave Cluster Tuning

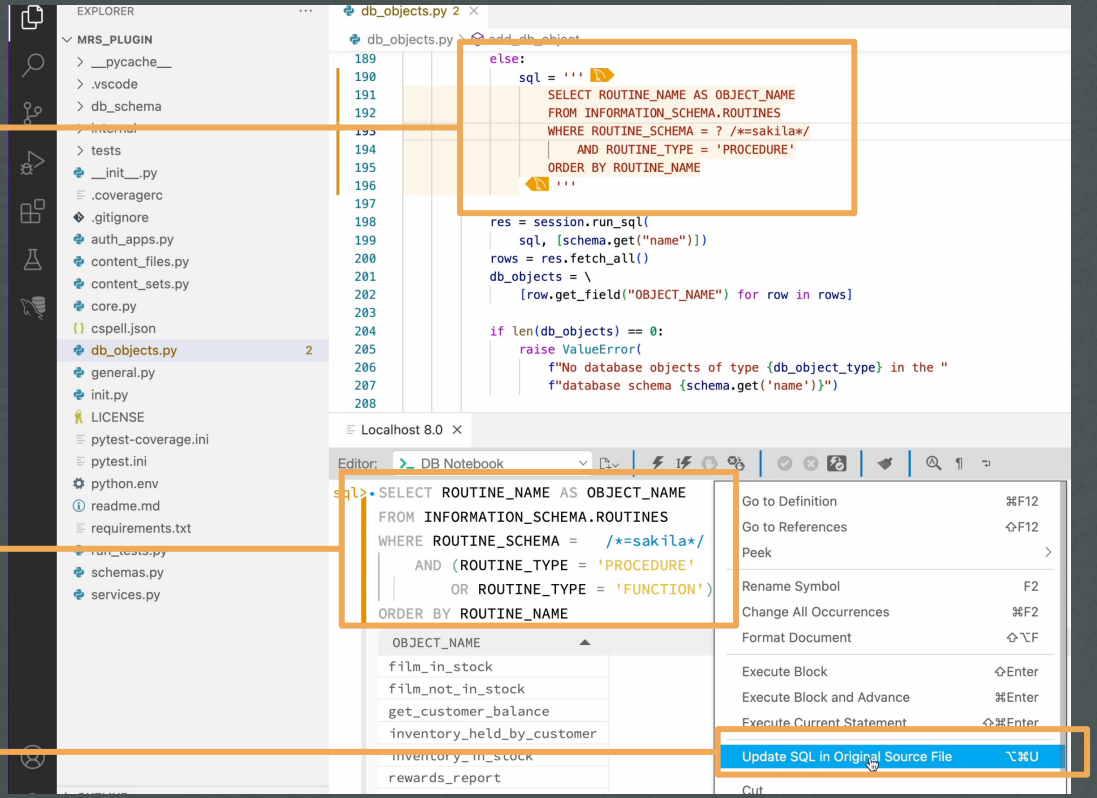


Executing Embedded SQL

Execute SQL Snippets in MySQL Shell

DB Notebook interface

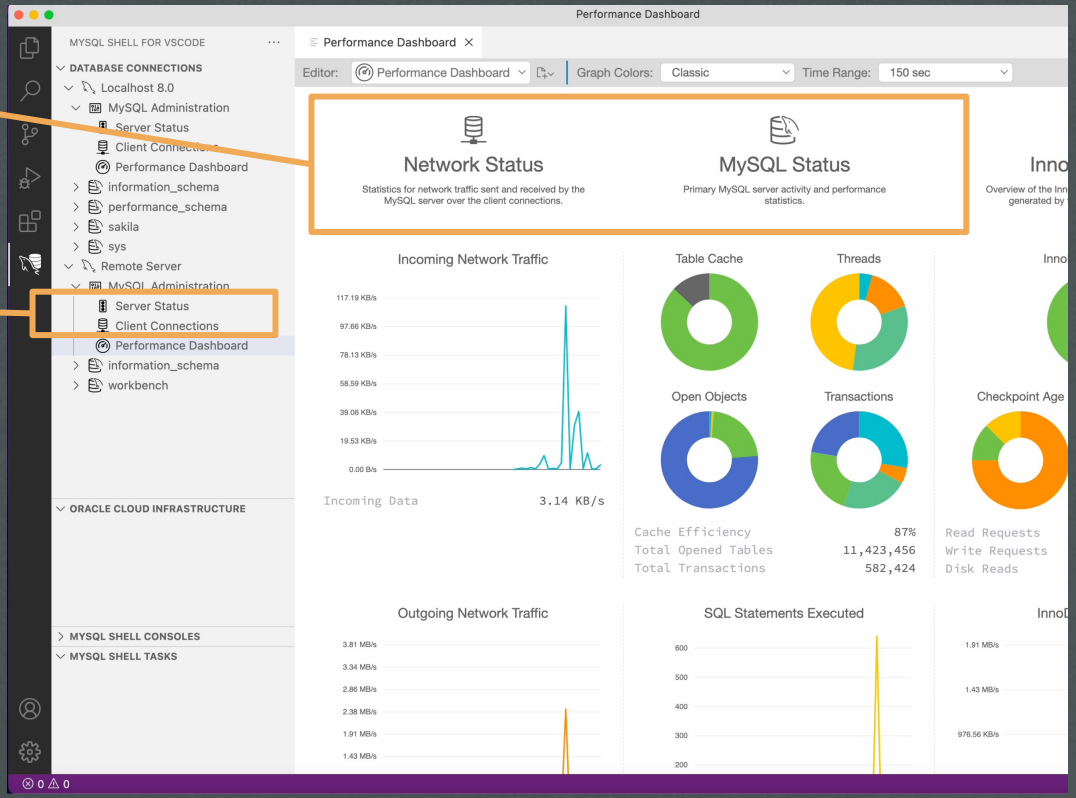
Update SQL Snippets into source



MySQL Administration

MySQL Performance Metrics

Quick overview of Server Status



MySQL REST Service

Fast, Secure HTTPS Access for your MySQL Data

RESTful Web Services

- Auto REST for tables, views and procedures
- {JSON} responses
- Paged results
- Developer support (GUI, CLI, API)

MySQL Shell for VS Code

- GUI frontend for MRS management
- RESTful Web Service creation
- Interactive documentation
- CLI & scripting support

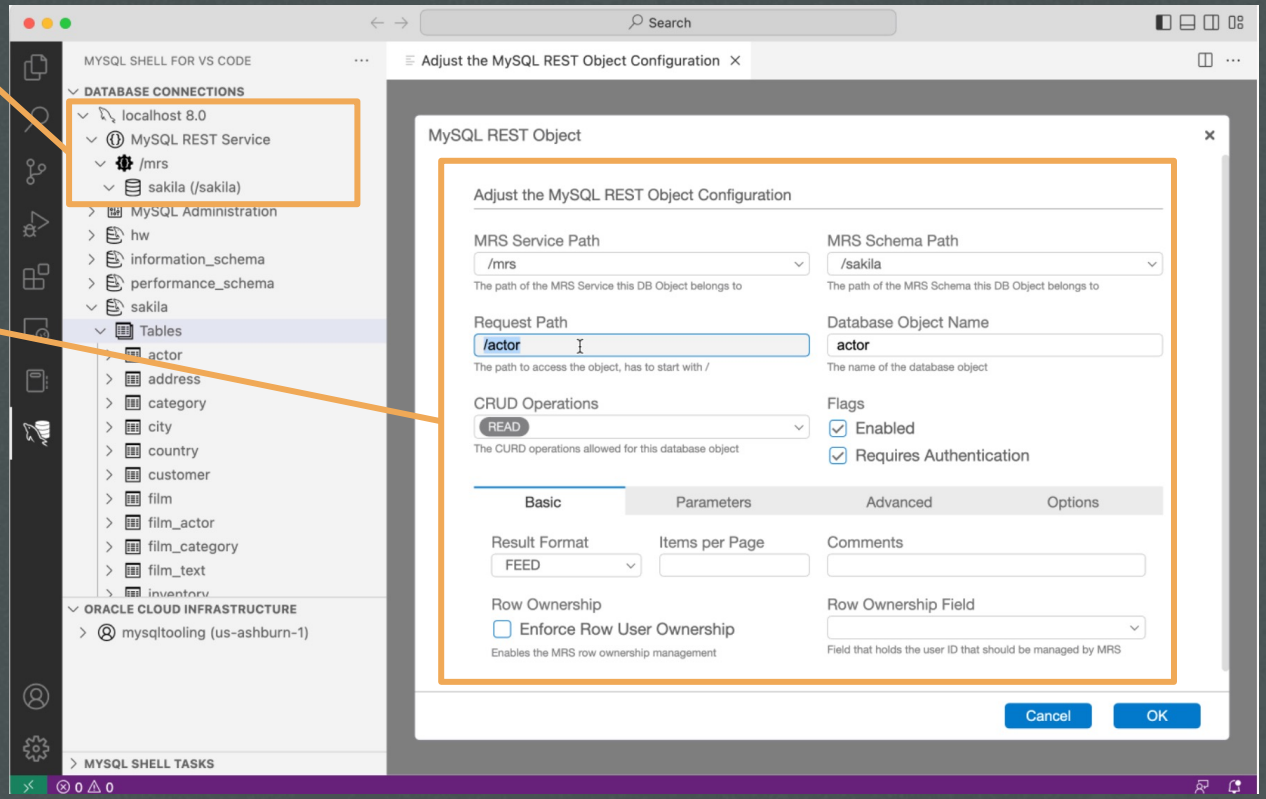
Built in User Management

- Support for popular OAuth2 services
- Use Role, Group & Hierarchy Management
- User management GUI
- CLI & scripting support

MySQL REST Service

Manage REST Service

Create REST Objects by mapping them to database objects



Summary

- MySQL Shell's goal is to be the primary frontend for most of MySQL functionality
- It's an unified interface for Developers and DBAs
- Brings ease of use for complex tasks
- Frontend manager for InnoDB Cluster and InnoDB ReplicaSet
- Extensible and open-source!

- ✓ Give it a try!
  dev.mysql.com/downloads/shell/
- ✓ Check and contribute to lefred's collection of MySQL Shell plugins:
  github.com/lefred/mysqlshell-plugins
- ✓ Reach us out on Slack!
  mysqlcommunity.slack.com
  #shell | #mysql_innodb_cluster

Thank you!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