Accessing Databases with SQL Magic

Estimated time needed: **15** minutes

Objectives

After completing this lab you will be able to:

- Perform simplified database access using SQL "magic"

To communicate with SQL Databases from within a JupyterLab notebook, we can use the SQL "magic" provided by the ipython-sql extension. "Magic" is JupyterLab's term for special commands that start with "%". Below, we'll use the *load_ext* magic to load the ipython-sql extension. In the lab environemnt provided in the course the ipython-sql extension is already installed and so is the ibm_db_sa driver.

In [ ]:
```
!pip install ipython-sql
%load_ext sql
```

Here you will be creating and connecting to a new SQlite database SQLiteMagic.

The syntax for connecting to magic sql using sqllite is

%sql sqlite://DatabaseName

where DatabaseName will be your **.db** file

In [2]:
```
import csv, sqlite3

con = sqlite3.connect("SQLiteMagic.db")
cur = con.cursor()
```

In [3]:
```
%sql sqlite:///SQLiteMagic.db
```

For convenience, we can use %%sql (two %'s instead of one) at the top of a cell to indicate we want the entire cell to be treated as SQL. Let's use this to create a table and fill it with some test data for experimenting.

In [4]:
```
%%sql

CREATE TABLE INTERNATIONAL_STUDENT_TEST_SCORES (
        country VARCHAR(50),
        first_name VARCHAR(50),
        last_name VARCHAR(50),
        test_score INT
);
INSERT INTO INTERNATIONAL_STUDENT_TEST_SCORES (country, first_name, last_name, test_score)
VALUES
('United States', 'Marshall', 'Bernadot', 54),
('Ghana', 'Celinda', 'Malkin', 51),
('Ukraine', 'Guillermo', 'Furze', 53),
('Greece', 'Aharon', 'Tunnow', 48),
('Russia', 'Bail', 'Goodwin', 46),
('Poland', 'Cole', 'Winteringham', 49),
('Sweden', 'Emlyn', 'Erricker', 55),
('Russia', 'Cathee', 'Sivewright', 49),
('China', 'Barny', 'Ingerson', 57),
('Uganda', 'Sharla', 'Papaccio', 55),
('China', 'Stella', 'Youens', 51),
('Poland', 'Julio', 'Buesden', 48),
('United States', 'Tiffie', 'Cosely', 58),
('Poland', 'Auroora', 'Stiffell', 45),
('China', 'Clarita', 'Huet', 52),
('Poland', 'Shannon', 'Goulden', 45),
('Philippines', 'Emylee', 'Privost', 50),
('France', 'Madelina', 'Burk', 49),
('China', 'Saunderson', 'Root', 58),
('Indonesia', 'Bo', 'Waring', 55),
('China', 'Hollis', 'Domotor', 45),
('Russia', 'Robbie', 'Collip', 46),
('Philippines', 'Davon', 'Donisi', 46),
('China', 'Cristabel', 'Radeliffe', 48),
('China', 'Wallis', 'Bartleet', 58),
('Moldova', 'Arleen', 'Stailey', 38),
('Ireland', 'Mendel', 'Grumble', 58),
('China', 'Sallyann', 'Exley', 51),
('Mexico', 'Kain', 'Swaite', 46),
('Indonesia', 'Alonso', 'Bulteel', 45),
('Armenia', 'Anatol', 'Tankus', 51),
('Indonesia', 'Coralyn', 'Dawkins', 48),
('China', 'Deanne', 'Edwinson', 45),
('China', 'Georgiana', 'Epple', 51),
```

```
('Portugal', 'Bartlet', 'Breese', 56),
('Azerbaijan', 'Idalina', 'Lukash', 50),
('France', 'Livvie', 'Flory', 54),
('Malaysia', 'Nonie', 'Borit', 48),
('Indonesia', 'Clio', 'Mugg', 47),
('Brazil', 'Westley', 'Measor', 48),
('Philippines', 'Katrinka', 'Sibbert', 51),
('Poland', 'Valentia', 'Mounch', 50),
('Norway', 'Sheilah', 'Hedditch', 53),
('Papua New Guinea', 'Itch', 'Jubb', 50),
('Latvia', 'Stesha', 'Garnson', 53),
('Canada', 'Cristionna', 'Wadmore', 46),
('China', 'Lianna', 'Gatward', 43),
('Guatemala', 'Tanney', 'Vials', 48),
('France', 'Alma', 'Zavittieri', 44),
('China', 'Alvira', 'Tamas', 50),
('United States', 'Shanon', 'Peres', 45),
('Sweden', 'Maisey', 'Lynas', 53),
('Indonesia', 'Kip', 'Hothersall', 46),
('China', 'Cash', 'Landis', 48),
('Panama', 'Kennith', 'Digance', 45),
('China', 'Ulberto', 'Riggeard', 48),
('Switzerland', 'Judy', 'Gilligan', 49),
('Philippines', 'Tod', 'Trevaskus', 52),
('Brazil', 'Herold', 'Heggs', 44),
('Latvia', 'Verney', 'Note', 50),
('Poland', 'Temp', 'Ribey', 50),
('China', 'Conroy', 'Egdal', 48),
('Japan', 'Gabie', 'Alessandone', 47),
('Ukraine', 'Devlen', 'Chaperlin', 54),
('France', 'Babbette', 'Turner', 51),
('Czech Republic', 'Virgil', 'Scotney', 52),
('Tajikistan', 'Zorina', 'Bedow', 49),
('China', 'Aidan', 'Rudeyeard', 50),
('Ireland', 'Saunder', 'MacLice', 48),
('France', 'Waly', 'Brunstan', 53),
('China', 'Gisele', 'Enns', 52),
('Peru', 'Mina', 'Winchester', 48),
('Japan', 'Torie', 'MacShirrie', 50),
('Russia', 'Benjamen', 'Kenford', 51),
('China', 'Etan', 'Burn', 53),
('Russia', 'Merralee', 'Chaperlin', 38),
('Indonesia', 'Lanny', 'Malam', 49),
('Canada', 'Wilhelm', 'Deeprose', 54),
('Czech Republic', 'Lari', 'Hillhouse', 48),
('China', 'Ossie', 'Woodley', 52),
('Macedonia', 'April', 'Tyer', 50),
('Vietnam', 'Madelon', 'Dansey', 53),
('Ukraine', 'Korella', 'McNamee', 52),
('Jamaica', 'Linnea', 'Cannam', 43),
('China', 'Mart', 'Coling', 52),
('Indonesia', 'Marna', 'Causbey', 47),
('China', 'Berni', 'Daintier', 55),
('Poland', 'Cynthia', 'Hassell', 49),
('Canada', 'Carma', 'Schule', 49),
('Indonesia', 'Malia', 'Blight', 48),
('China', 'Paulo', 'Seivertsen', 47),
('Niger', 'Kaylee', 'Hearley', 54),
('Japan', 'Maure', 'Jandak', 46),
('Argentina', 'Foss', 'Feavers', 45),
('Venezuela', 'Ron', 'Leggitt', 60),
('Russia', 'Flint', 'Gokes', 40),
('China', 'Linet', 'Conelly', 52),
('Philippines', 'Nikolas', 'Birtwell', 57),
('Australia', 'Eduard', 'Leipelt', 53)
 * sqlite:///SQLiteMagic.db
Done.
99 rows affected.
```

Out[4]: []

In [ ]:
```
# Install the 'ipython-sql' and 'prettytable' libraries using pip
!pip install ipython-sql prettytable

# Import the 'prettytable' library, which is used to display data in a formatted table
import prettytable

# Set the default display format for prettytable to 'DEFAULT' (i.e., a simple table format)
prettytable.DEFAULT = 'DEFAULT'
```

Using Python Variables in your SQL Statements

You can use python variables in your SQL statements by adding a ":" prefix to your python variable names.

For example, if I have a python variable `country` with a value of `"Canada"`, I can use this variable in a SQL query to find all the rows of students from Canada.

In [6]:
```
country = "Canada"
%sql select * from INTERNATIONAL_STUDENT_TEST_SCORES where country = :country
```

```
 * sqlite:///SQLiteMagic.db
Done.
```

Out[6]:

country	first_name	last_name	test_score
Canada	Cristionna	Wadmore	46
Canada	Wilhelm	Deeprose	54
Canada	Carma	Schule	49

Assigning the Results of Queries to Python Variables

You can use the normal python assignment syntax to assign the results of your queries to python variables.

For example, I have a SQL query to retrieve the distribution of test scores (i.e. how many students got each score). I can assign the result of this query to the variable `test_score_distribution` using the `=` operator.

In [7]:
```
test_score_distribution = %sql SELECT test_score as "Test_Score", count(*) as "Frequency" from INTERNATIONAL_STUDENT_TEST_SCORES GROUP BY test_score;
test_score_distribution
```

```
 * sqlite:///SQLiteMagic.db
Done.
```

Out[7]:

Test_Score	Frequency
38	2
40	1
43	2
44	2
45	8
46	7
47	4
48	14
49	8
50	10
51	8
52	8
53	8
54	5
55	4
56	1
57	2
58	4
60	1

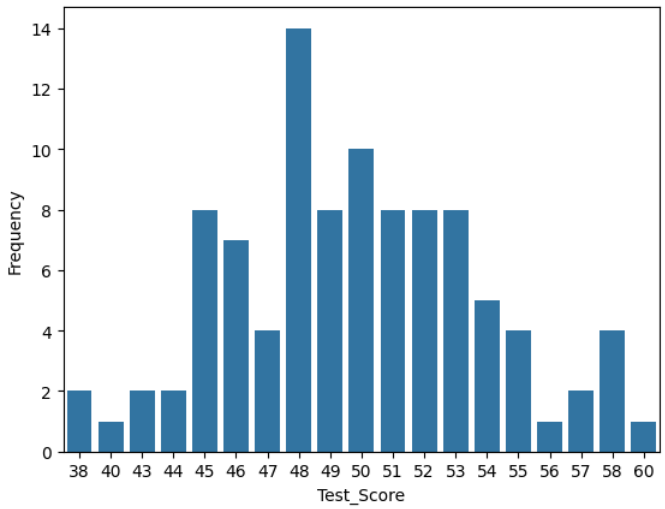
Converting Query Results to DataFrames

You can easily convert a SQL query result to a pandas dataframe using the `DataFrame()` method. Dataframe objects are much more versatile than SQL query result objects. For example, we can easily graph our test score distribution after converting to a dataframe.

In [9]:
```
#!pip install seaborn
#!pip install matplotlib
dataframe = test_score_distribution.DataFrame()

%matplotlib inline
# uncomment the following line if you get an module error saying seaborn not found
# !pip install seaborn==0.9.0
import seaborn

plot = seaborn.barplot(x='Test_Score',y='Frequency', data=dataframe)
```



Now you know how to work within JupyterLab notebooks using SQL "magic"!

In [11]:
```
%%sql

-- Feel free to experiment with the data set provided in this notebook for practice:
SELECT country, first_name, last_name, test_score FROM INTERNATIONAL_STUDENT_TEST_SCORES LIMIT 10;
```

```
 * sqlite:///SQLiteMagic.db
Done.
```

Out[11]:

country	first_name	last_name	test_score
United States	Marshall	Bernadot	54
Ghana	Celinda	Malkin	51
Ukraine	Guillermo	Furze	53
Greece	Aharon	Tunnow	48
Russia	Bail	Goodwin	46
Poland	Cole	Winteringham	49
Sweden	Emlyn	Erricker	55
Russia	Cathee	Sivewright	49
China	Barny	Ingerson	57
Uganda	Sharla	Papaccio	55

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