(https://www.bigdatauniversity.com)

Accessing Databases with SQL Magic

After using this notebook, you will know how to perform simplified database access using SQL "magic". You will connect to a Db2 database, issue SQL commands to create tables, insert data, and run queries, as well as retrieve results in a Python dataframe.

To communicate with SQL Databases from within a JupyterLab notebook, we can use the SQL "magic" provided by the ipython-sql (https://github.com/catherinedevlin/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 [1]:

```
%load_ext sql
```

Now we have access to SQL magic. With our first SQL magic command, we'll connect to a Db2 database. However, in order to do that, you'll first need to retrieve or create your credentials to access your Db2 database.

This image shows the location of your connection string if you're using Db2 on IBM Cloud. If you're using another host the format is: username:password@hostname:port/database-name

In [3]:

```
# Enter your Db2 credentials in the connection string below
# Recall you created Service Credentials in Part III of the first lab of the course in Week 1
# i.e. from the uri field in the Service Credentials copy everything after db2:// (but remove the double quote at the end)
# for example, if your credentials are as in the screenshot above, you would write:
# %sql ibm_db_sa://my-username:my-password@dashdb-txn-sbox-yp-dal09-03.services.dal.bluemix.net:50000/BLUDB
# Note the ibm_db_sa:// prefix instead of db2://
# This is because JupyterLab's ipython-sql extension uses sqlalchemy (a python SQL toolkit)
# which in turn uses IBM's sqlalchemy dialect: ibm_db_sa
%sql ibm_db_sa://sdp03042:5df-tzzcfp3mx76d@dashdb-txn-sbox-yp-lon02-02.services.eu-gb.bluemix.net:50000/BLUDB
```

Out[3]:

'Connected: sdp03042@BLUDB'

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
%%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)
```

  * ibm_db_sa://sdp03042:***@dashdb-txn-sbox-yp-lon02-02.services.eu-gb.bluemix.net:50000/BL
UDB
Done.
99 rows affected.

Out[4]:

[]

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 [5]:

```
country = "Canada"
%sql select * from INTERNATIONAL_STUDENT_TEST_SCORES where country = :country
```

  * ibm_db_sa://sdp03042:***@dashdb-txn-sbox-yp-lon02-02.services.eu-gb.bluemix.net:50000/BL
UDB
Done.

Out[5]:

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 [6]:

```
test_score_distribution = %sql SELECT test_score as "Test Score", count(*) as "Frequency" from INTERNATIONAL_ST
UDENT_TEST_SCORES GROUP BY test_score;
test_score_distribution
```

 * ibm_db_sa://sdp03042:***@dashdb-txn-sbox-yp-lon02-02.services.eu-gb.bluemix.net:50000/BL
UDB
Done.

Out[6]:

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 [7]:

```python
dataframe = test_score_distribution.DataFrame()

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

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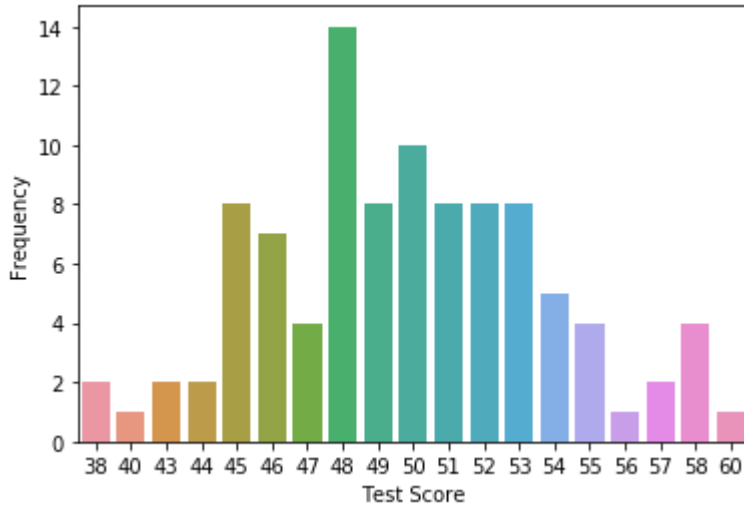

Now you know how to work with Db2 from within JupyterLab notebooks using SQL "magic"!

In [8]:

```sql
%%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;
```

 * ibm_db_sa://sdp03042:***@dashdb-txn-sbox-yp-lon02-02.services.eu-gb.bluemix.net:50000/BL
UDB
Done.

Out[8]:

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
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