Amazon Web Services

Data Engineering Immersion Day

Bridging Data for AI/ML using Amazon SageMaker

July 2021

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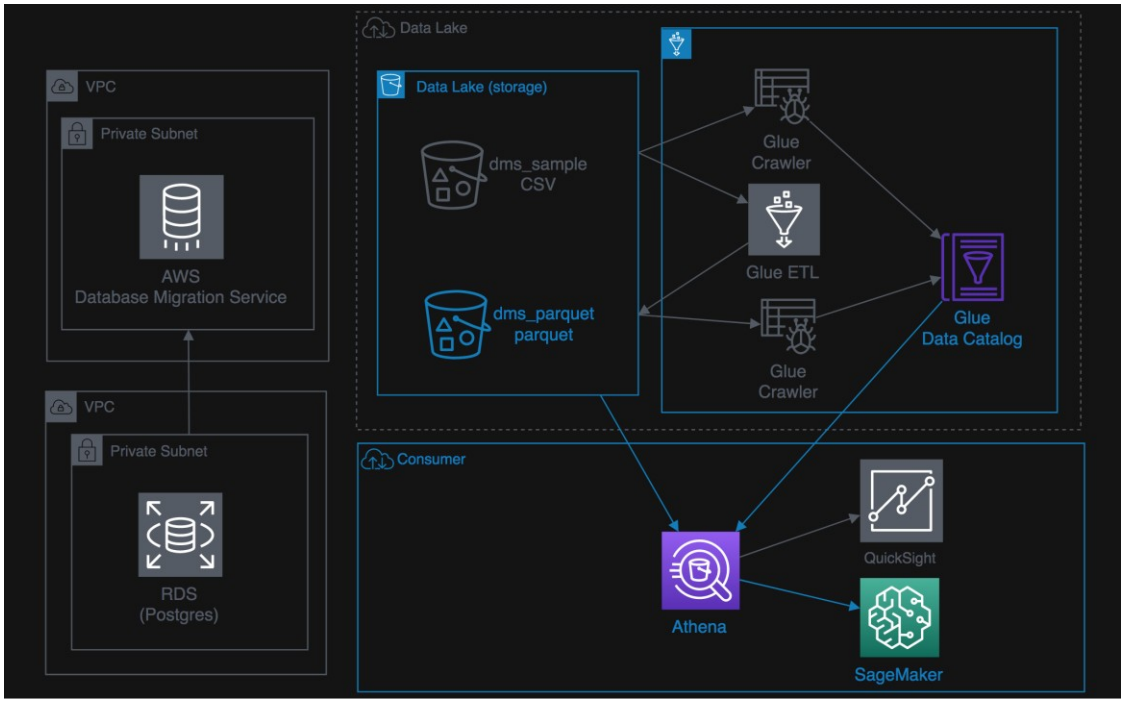
Introduction

Amazon SageMaker is an end-to-end machine learning platform that lets you build, train, and deploy machine learning models in AWS. It is a highly modular service that lets you use each ofthese components independently of each other.

You will Learn:

- How to use the Jupyter notebook component of Sagemaker to integrate with the datalake using Athena
- Populate data frames for data manipulation.

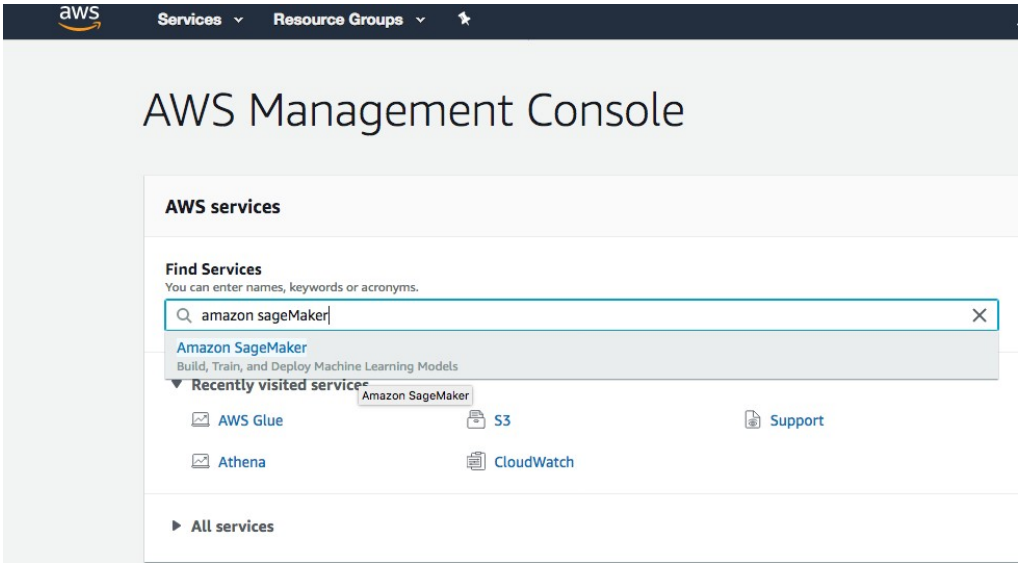


This process to prepare the data to satisfy the needs of ML algorithms is iterative. To prepare the data, we will make the table definitions in Athena available in a Jupyter notebook instanceof SageMaker.

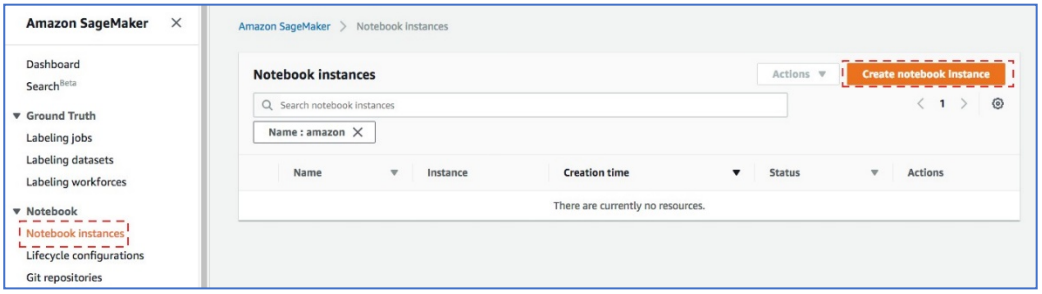
Jupyter notebooks are popular among data scientists and used to visualize data, perform statistical analysis, complete data manipulations, and make the data ready for machine learning work.

Create Amazon SageMaker Notebook Instance

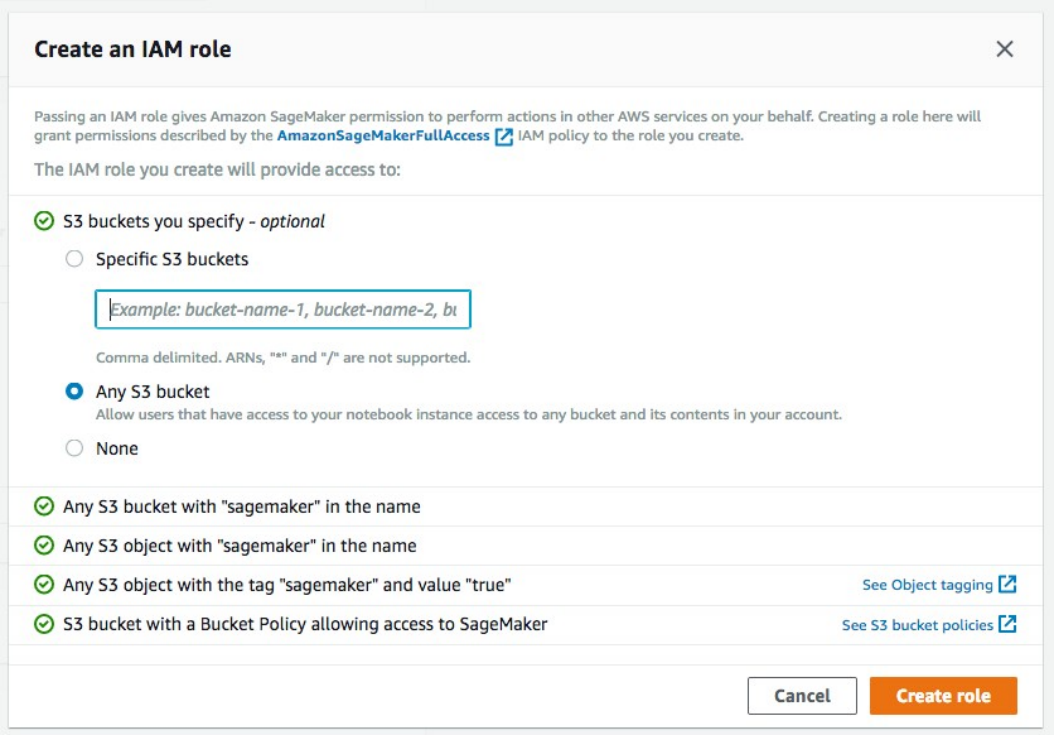
1. Go to the [Amazon Sagemaker](#) from AWS console



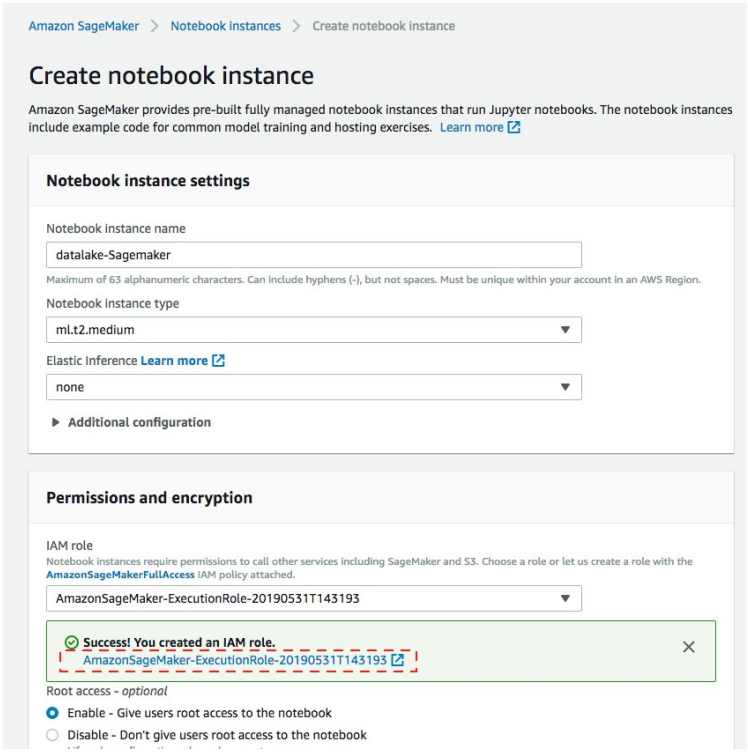
2. In the Amazon SageMaker navigation pane, click Notebook instances and Click Createnotebook instance.



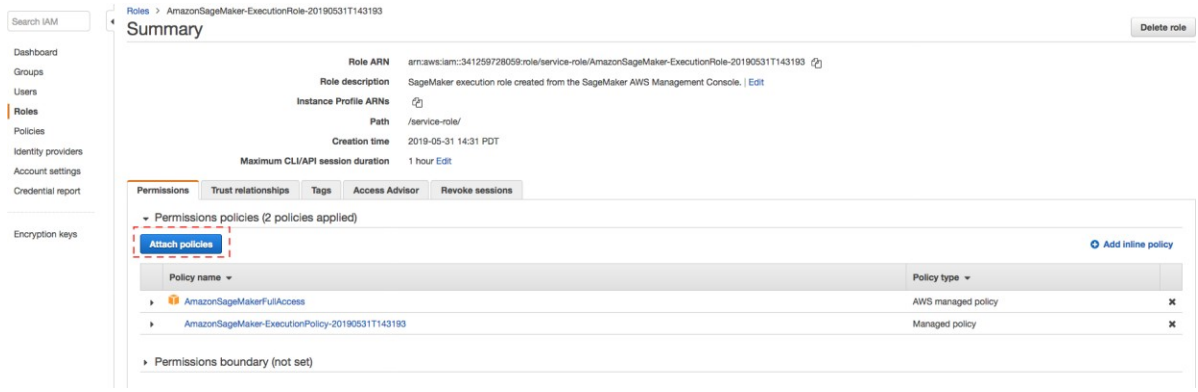
3. Put following values to create instance
    a. Give your choice of name for Notebook instance name e.g., "**datalake-Sagemaker**"
    b. You can leave Notebook instance type as default value "ml.t2.medium" for thislab.
    c. Leave Elastic Inference as null. This is to add extra resources.
    d. Choose a role for the notebook instances in Amazon SageMaker to interact with Amazon S3. As role doesn't exist select the Create new role option.
    e. In Create an IAM Role pop up window, choose the specific S3 bucket you will grant access to. For this lab, choose Any S3 bucket as shown below and click Create Role:



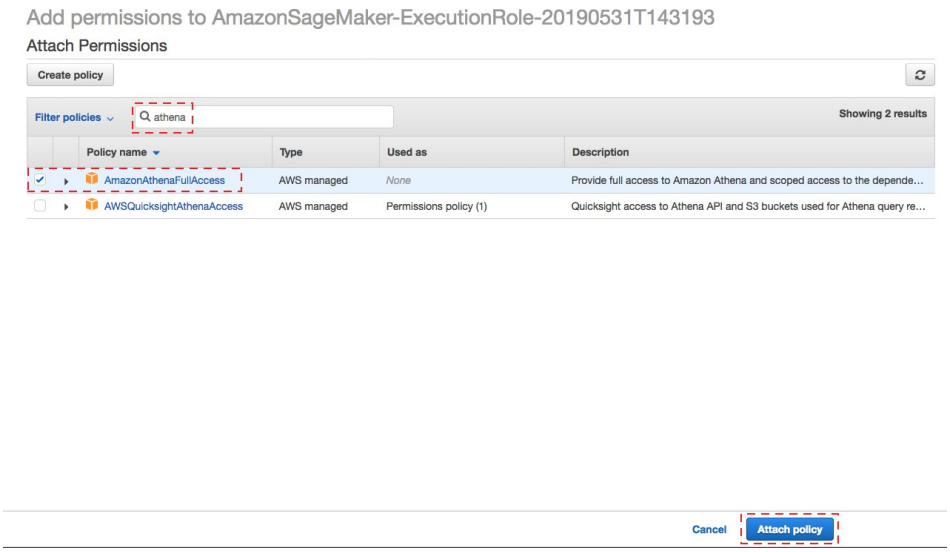
f. You will see a Role got create, as you are going to Access Athena from SageMaker, so SageMaker execution role must have the necessary permission to access Athena. To achieve that click the link for newly created IAM Role andin the new window



g. There is no Athena permission available in your SageMaker execution role. Inthis case, it is “AmazonSageMaker-ExecutionRole-20190531T143193”. Click Attach Policies button in Permissions tab.

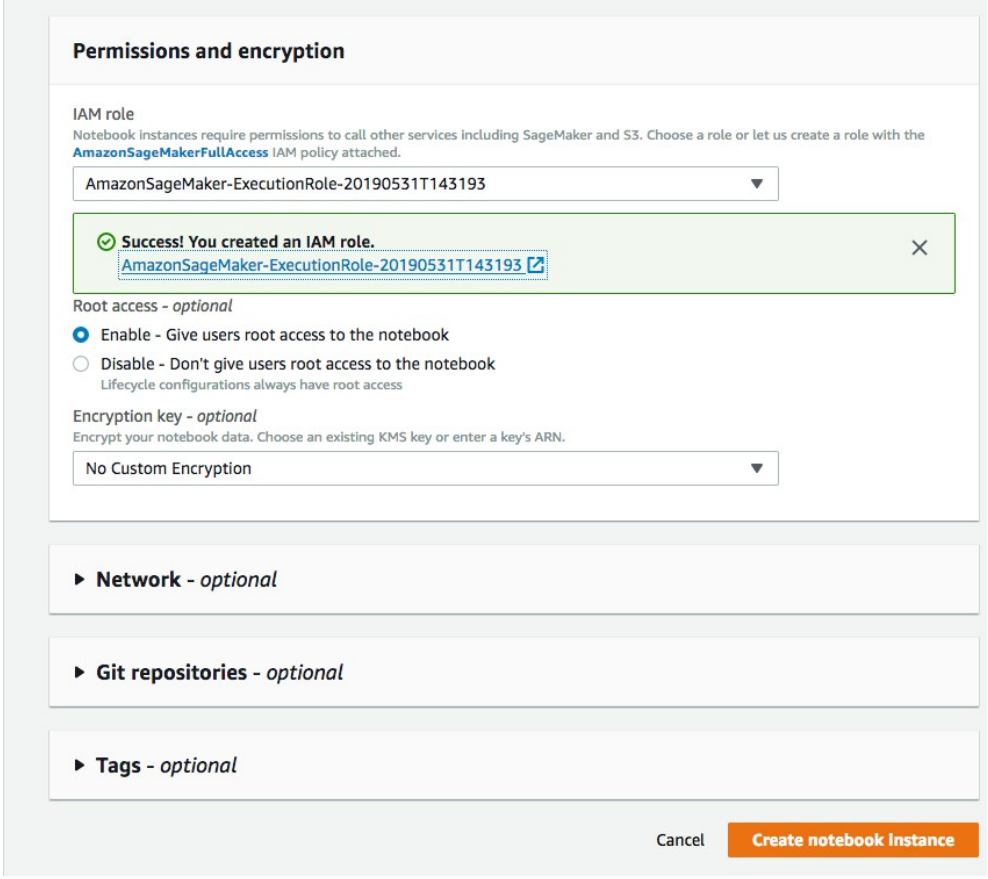


h. Filter policies by “Athena”, check AmazonAthenaFullAccess managed policyand click Attach Policy button at the bottom of the screen. Close the new window/tab.

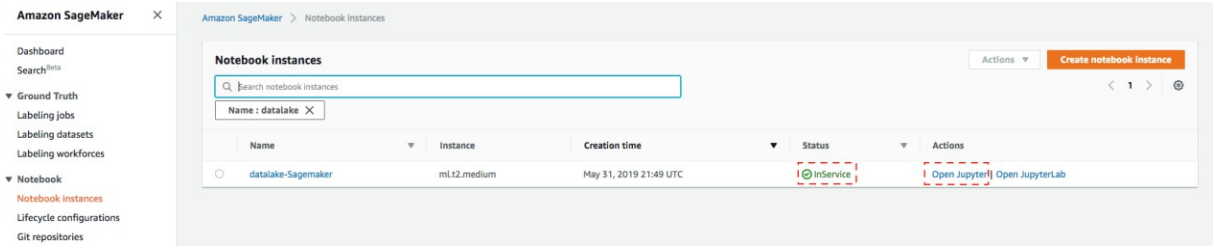


After Athena policy to IAM Role, you can close this window and go backSageMaker browser window.

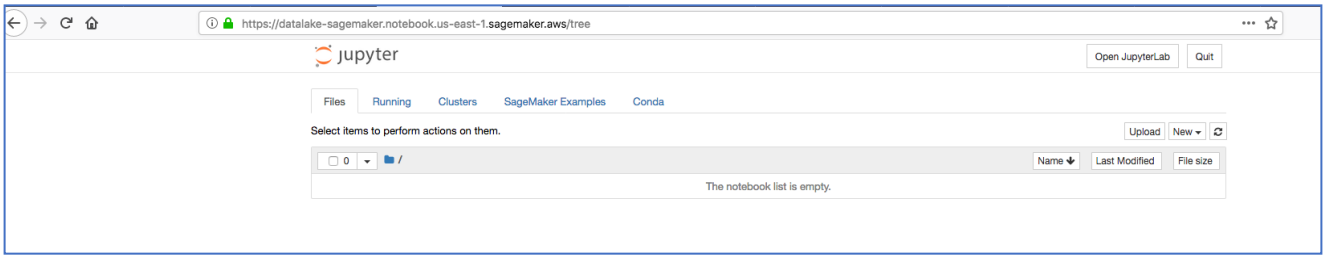
i. Leave all other options default. Click Create notebook instance.



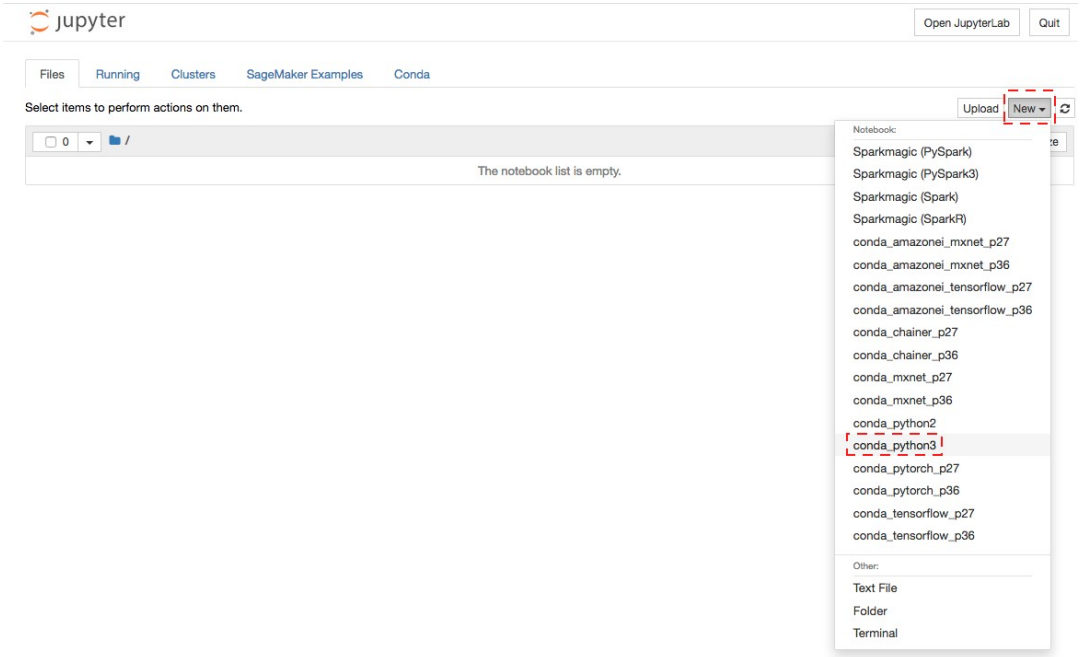
4. Wait for the notebook instances to be created and the Status to change to Inservice and Click Open Jupyter in from "Actions" column.



5. The notebook interface opens in a separate browser window.



Connect the SageMaker Jupyter notebook to Athena

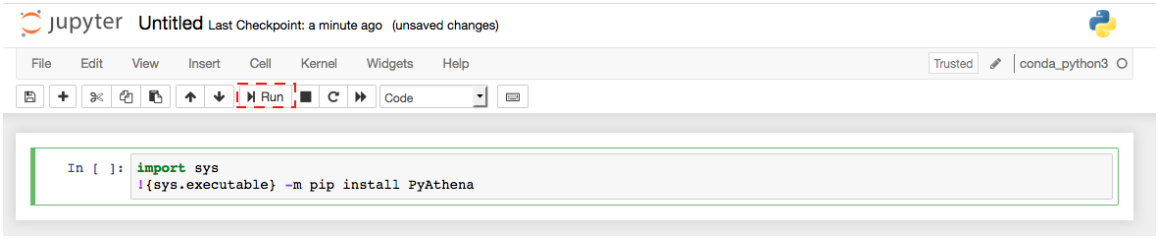


1. In the Jupyter notebook interface, click New. For the kernel, choose conda_python3.

   Note: Amazon SageMaker provides several kernels for Jupyter, including support for Python 2 and Python 3, MXNet, TensorFlow, and PySpark. This exercise uses Python because it includes the Pandas library.

2. Within the notebook, execute the following commands to install the Athena JDBCdriver and in the top toolbar, click Run. (PyAthena is a Python DB API 2.0 (PEP 249) compliant client for the Amazon Athena JDBC driver.)

```
import sys
!{sys.executable} -m pip install PyAthena
```



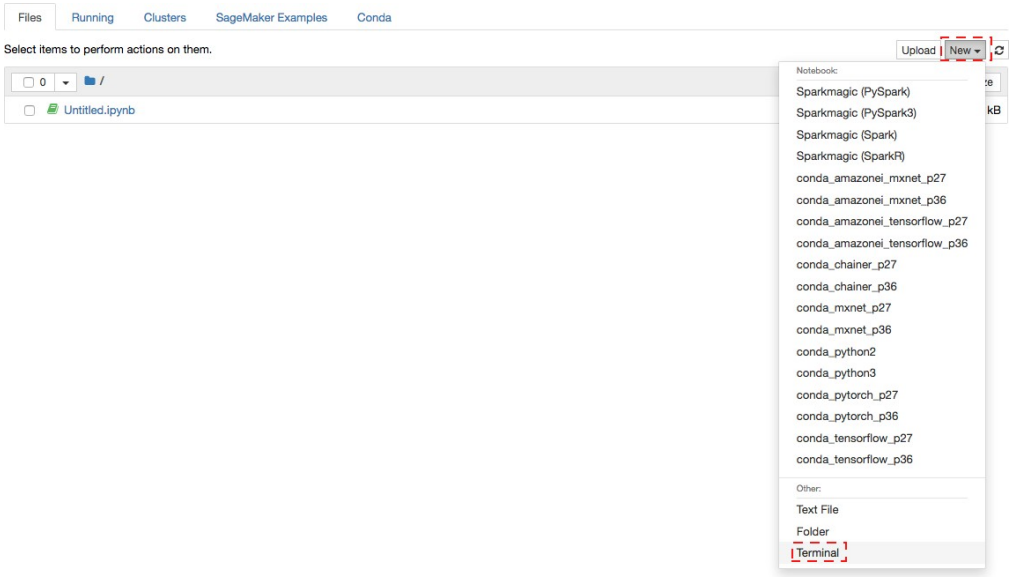
Observe success message in log:

```
In [1]: import sys
        !{sys.executable} -m pip install PyAthena

Collecting PyAthena
  Downloading https://files.pythonhosted.org/packages/32/b6/841b79b42dad6044429596bfed6f669131b59328fa630171538d85adf
fbe/PyAthena-1.6.1-py2.py3-none-any.whl (50kB)
    100% |████████████████████████████████| 51kB 18.3MB/s ta 0:00:01
Requirement already satisfied: botocore>=1.5.52 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-packages
(from PyAthena) (1.12.146)
Collecting future (from PyAthena)
  Downloading https://files.pythonhosted.org/packages/90/52/e20466b85000a181e1e144fd8305caf2cf475e2f9674e797b222f8105
f5f/future-0.17.1.tar.gz (829kB)
    100% |████████████████████████████████| 829kB 21.3MB/s ta 0:00:01
Collecting tenacity>=4.1.0 (from PyAthena)
  Downloading https://files.pythonhosted.org/packages/6a/93/dfcf5b1b46ab29196274b78dcba69fab5e54b6dc303a7eed90a79194d
277/tenacity-5.0.4-py2.py3-none-any.whl
Requirement already satisfied: boto3>=1.4.4 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-packages (fro
m PyAthena) (1.9.146)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-pac
kages (from botocore>=1.5.52->PyAthena) (0.9.4)
Requirement already satisfied: docutils>=0.10 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-packages (f
rom botocore>=1.5.52->PyAthena) (0.14)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1; python_version >= "2.7" in /home/ec2-user/anaconda3/envs/
python3/lib/python3.6/site-packages (from botocore>=1.5.52->PyAthena) (2.7.3)
Requirement already satisfied: urllib3<1.25,>=1.20; python_version >= "3.4" in /home/ec2-user/anaconda3/envs/python3/
lib/python3.6/site-packages (from botocore>=1.5.52->PyAthena) (1.23)
Requirement already satisfied: six>=1.9.0 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-packages (from
tenacity>=4.1.0->PyAthena) (1.11.0)
Requirement already satisfied: s3transfer<0.3.0,>=0.2.0 in /home/ec2-user/anaconda3/envs/python3/lib/python3.6/site-p
ackages (from boto3>=1.4.4->PyAthena) (0.2.0)
Building wheels for collected packages: future
  Running setup.py bdist_wheel for future ... done
  Stored in directory: /home/ec2-user/.cache/pip/wheels/0c/61/d2/d6b7317325828fbb39ee6ad559dbe4664d0896da4721bf379e
Successfully built future
Installing collected packages: future, tenacity, PyAthena
Successfully installed PyAthena-1.6.1 future-0.17.1 tenacity-5.0.4
```

***Note: If an error occurs**, you may be required to set a file system path for an applicationthat helps build the driver software. If this is the case, follow these steps.*

a. In your home notebook window, select New > Terminal.



b. Copy following command and press Enter.

```
sudo ln -s  /usr/libexec/gcc/x86_64-amazon-linux/4.8.5/cc1plus /usr/local/bin/
```

c. Run the original paragraph code from Step 2 again to build the AthenaJDBCdriver.

Working in Pandas

After the Athena driver is installed, you can use the JDBC connection to connect to Athena andpopulate the Pandas data frames. For data scientists, working with data is typically divided into multiple stages: ingesting and cleaning data, analyzing and modeling data, then organizing the results of the analysis into a form suitable for plotting or tabular display. Pandasis the ideal tool for all of these tasks.

1. You can load Athena table data from data lake to Pandas data frame and apply machine learning. Copy following code in your notebook and replace following:
    a. Account number: Run the following command in the notebook cell and get the AWS account Id.

```
!aws sts get-caller-identity --query Account
```

```
In [7]: !aws sts get-caller-identity --query Account
        "913536263025"
```

    b. Your region: Run the following command in the notebook cell and get the current AWS region.

```
!aws configure get region
```

```
In [8]: !aws configure get region
        eu-west-1
```

    c. Your Athena Database name, this is the Glue Database name which you createdduring previous lab e.g., "**ticketdata**". If the S3 bucket doesn't exist then create it in the correct region.

```
from pyathena import connect
import pandas as pd
conn = connect(s3_staging_dir='s3://aws-athena-query- results-<youraccountnumber>-<yourregion>/',
region_name='<yourregion>')

df = pd.read_sql('SELECT * FROM "<yourathenadatabase>"."nfl_stadium_data" order by stadium limit 10;',
conn)
df
```

2. Click Run and data frame will display query output.

```
In [3]: from pyathena import connect
        import pandas as pd
        conn = connect(s3_staging_dir='s3://aws-athena-query-results-[redacted]-us-east-1/',
                       region_name='us-east-1')

        df = pd.read_sql('SELECT * FROM "ticketdata"."nfl_stadium_data"  order by stadium limit 10;', conn)
        df
```

Out[3]:

	stadium	seating_capacity	location	surface	roof	team	opened	sport_location_id
0	AT&T Stadium	+8.0000000000000000e+04	"Arlington	Texas"	Matrix RealGrass artificial turf	Retractable	None	2009
1	Arrowhead Stadium	+7.6416000000000000e+04	"Kansas City	Missouri"	Latitude 36 Bermuda Grass	Open	None	1972
2	Bank of America Stadium	+7.5419000000000000e+04	"Charlotte	North Carolina"	Voyager Bermuda Grass	Open	None	1996
3	CenturyLink Field	+6.8000000000000000e+04	"Seattle	Washington"	FieldTurf Revolution	Open	None	2002
4	EverBank Field	+6.7246000000000000e+04	"Jacksonville	Florida"	Tifway 419 Bermuda Grass	Open	None	1995
5	FedExField	+8.2000000000000000e+04	"Landover	Maryland"	Latitude 36 Bermuda Grass	Open	None	1997
6	FirstEnergy Stadium	+6.7431000000000000e+04	"Cleveland	Ohio"	Kentucky Bluegrass	Open	None	1999
7	Ford Field	+6.5000000000000000e+04	"Detroit	Michigan"	FieldTurf Classic HD	Fixed	None	2002
8	Georgia Dome	+7.1250000000000000e+04	"Atlanta	Georgia"	FieldTurf Classic HD	Fixed	None	1992
9	Gillette Stadium	+6.6829000000000000e+04	"Foxborough	Massachusetts"	FieldTurf Revolution	Open	None	2002

In this query, you are loading all nfl statdium information to panda dataframe fromtable nfl_stadium_data.

Note:
if you get a SageMaker does not have Athena execution permissions error issue. You need to add Athena Access to the Sagemaker role as steps provide in previous section.

3. You can use apply different ML algorithm in populated Pandas data frames. For example, draw a plot. Copy following code in your notebook and replace Your Athena Database name; this is the Glue Database name which you created during previous lab
e.g., “ticketdata”.
In this query, you are loading all even ticket information to panda dataframe from table sporting_event_ticket_info.

```
df = pd.read_sql('SELECT sport, \
      event_date_time, \
      home_team,away_team, \
      city, \
      count(*) as tickets, \
      sum(ticket_price) as total_tickets_amt, \
      avg(ticket_price) as avg_ticket_price, \
      max(ticket_price) as max_ticket_price, \
      min(ticket_price) as min_ticket_price  \
      FROM "<yourathenadatabase>"."sporting_event_ticket_info" \
      group by 1,2,3,4,5 \
      order by 1,2,3,4,5  limit 1000;', conn)
df
```

4. Click Run and data frame will display query output

```
In [15]: df = pd.read_sql('SELECT sport,                    \
                           event_date_time,                \
                           home_team,away_team,            \
                               city,                       \
                               count(*) as tickets,        \
                               sum(ticket_price) as total_tickets_amt,          \
                               avg(ticket_price) as avg_ticket_price,           \
                               max(ticket_price) as max_ticket_price,           \
                               min(ticket_price) as min_ticket_price            \
                           FROM "ticketdata"."sporting_event_ticket_info" \
                           group by 1,2,3,4,5                                   \
                           order by 1,2,3,4,5          limit 1000;', conn)
df
```

Out[15]:

	sport	event_date_time	home_team	away_team	city	tickets	total_tickets_amt	avg_ticket_price	max_ticket_price	min_ticket_price
0	baseball	2019-04-07 00:00:00	Chicago Cubs	Milwaukee Brewers	Chicago Illinois	2792	130163.04	46.620000	77.70	31.08
1	baseball	2019-04-07 00:00:00	Cincinnati Reds	San Diego Padres	Cincinnati Ohio	2888	92322.14	31.967500	33.65	26.92
2	baseball	2019-04-07 00:00:00	Colorado Rockies	St. Louis Cardinals	Denver Colorado	3600	262764.00	72.990000	145.98	48.66
3	baseball	2019-04-07 00:00:00	Kansas City Royals	Colorado Rockies	Kansas City Missouri	2488	140024.64	56.280000	75.04	37.52
4	baseball	2019-04-07 00:00:00	San Francisco Giants	Cleveland Indians	San Francisco California	2848	109505.60	38.450000	61.52	30.76
5	baseball	2019-04-07 00:00:00	Tampa Bay Rays	New York Yankees	St. Petersburg Florida	1888	91983.36	48.720000	64.96	32.48
6	baseball	2019-04-07 00:00:00	Texas Rangers	Toronto Blue Jays	Arlington Texas	3400	178415.00	52.475000	83.96	41.98

```
In [ ]:
```

5. In new execution line copy following code

```
import matplotlib.pyplot as plt
df.plot(x='event_date_time',y='avg_ticket_price')
```

6. Click Run and you will see data plot which got draw using matplotlib library.

```
In [17]: import matplotlib.pyplot as plt
         df.plot(x='event_date_time',y='avg_ticket_price')
Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x7fca1c0b26d8>
```