Real Time Data Streaming Simulator

Project Overview

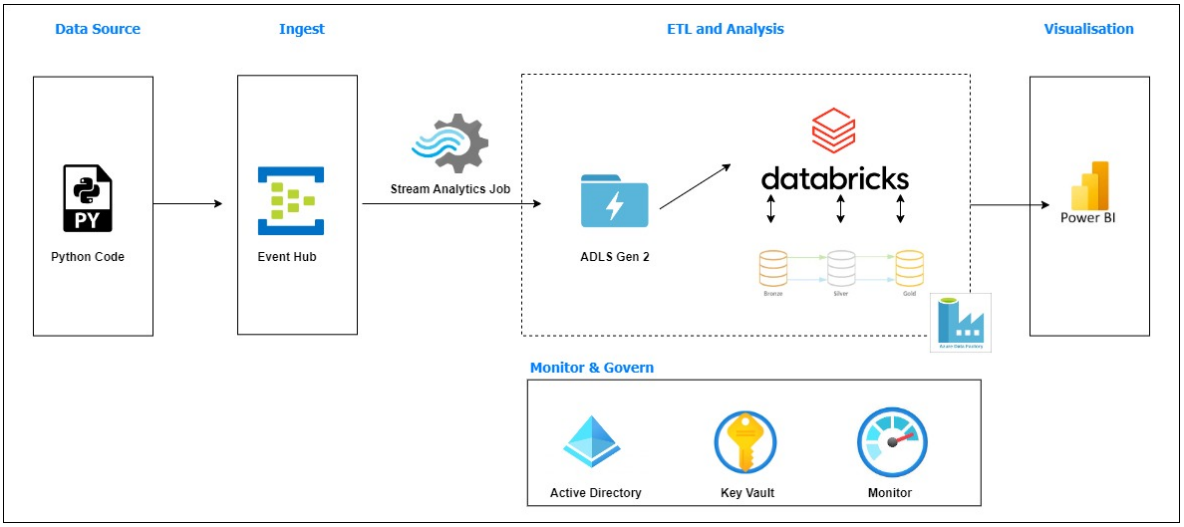
In this project we are going to build an End to End Data Engineering pipeline which simulates a real time data processing.

1. Problem statement

- Create a simulator code using python which generates the data. Using Azure services load the data, do transformations using Databricks and store it into a delta gold table.

2. High level description of the solution

- We have a device which generates the data at particular intervals(assume for every 5 minutes).
- Push this data into Kafka service (Azure EventHub)
- Load the data into ADLS using Stream Analytics job.
- When ever data is available in the ADLS, using ADF load the data from ADLS to Azure Databricks. Do the transformations.
- Connect the Power BI to Databricks for visualization. 📊



Data Collection and Ingestion

1. Data source

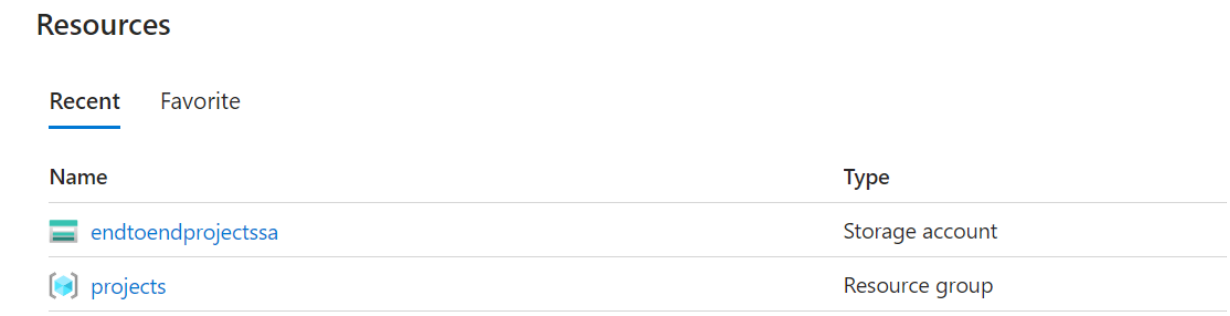
- Data source is a python code, where we create a Data frame using pandas by loading .csv file
    - **Details of the CSV file**
        - **Type of Data : Amazon Product ratings**
        - **Size : 1GB**
        - **No: columns : 4 (UserId, ProductId, Rating, Timestamp)**
- From the data frame, we are trying to push 1000 records every 3 minute into the Azure Eventhub.
- Below is the Python code

```
''''
 Install the below libraries which are helpful to connect with azure eventhub

1. pip install azure-eventhub
```

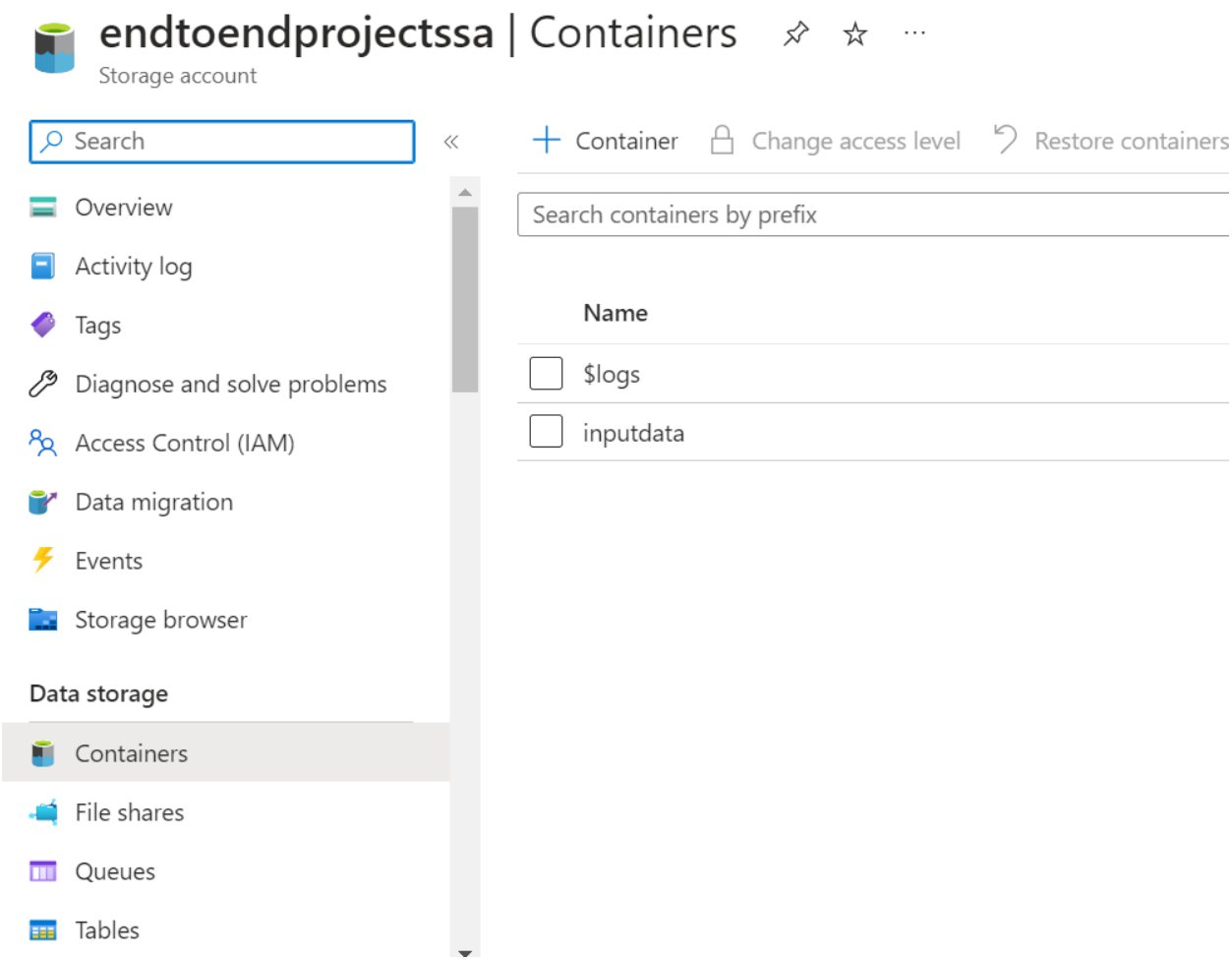
```
2. pip install azure-identity
3. pip install aiohttp

'''
# import required modules/libraries
import pandas as pd

import asyncio
import pandas as pd
import json
import time

from azure.eventhub import EventData
from azure.eventhub.aio import EventHubProducerClient
from azure.identity import DefaultAzureCredential


connection_str = 'Endpoint=sb://datasimulatornamespace.servicebus.windows.net/;SharedAccessKeyName=RootManageSharedAccessKey;SharedAccessKe
eventhub_name = 'datasimulatoreventhub'


#data file path
path = "C:\\Users\\RakeshAnkinapalli\\Downloads\\ratings_Beauty\\ratings_Beauty.csv"

#create dataframe using the given path
data = pd.read_csv(filepath_or_buffer=path)

#loop to get 1000 records every minute.
idx = 0
def get_record(idx):
    record = data.iloc[idx:(idx+1000)].to_dict('records')
    return record



async def main(idx):
    # Create a producer client to send messages to the event hub.
    # Specify a connection string to your event hubs namespace and
    # the event hub name.
    producer = EventHubProducerClient.from_connection_string(
        conn_str=connection_str, eventhub_name=eventhub_name
    )
    async with producer:
        # Create a batch.
        event_data_batch = await producer.create_batch()

        # Add events to the batch.
        event_data_batch.add(EventData(json.dumps(get_record(idx))))


        # Send the batch of events to the event hub.
        await producer.send_batch(event_data_batch)



#infinite loop runs to call the function which push data into eventhub
#And it sleeps for 1 minute
while True:
    asyncio.run(main(idx))
    time.sleep(60)
    idx += 1000
```

2. Create Resource Group, Storage Account

- While creating storage account enable hierarchical namespace for ADLS



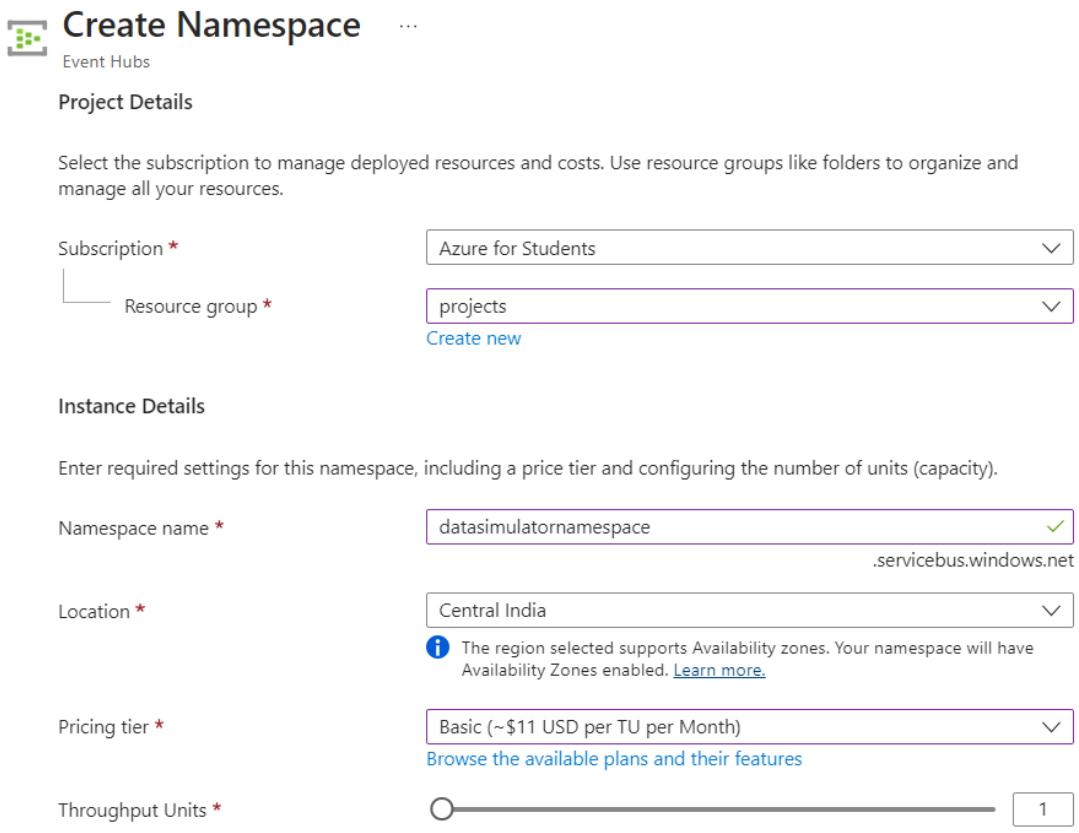
- Create a container called input data



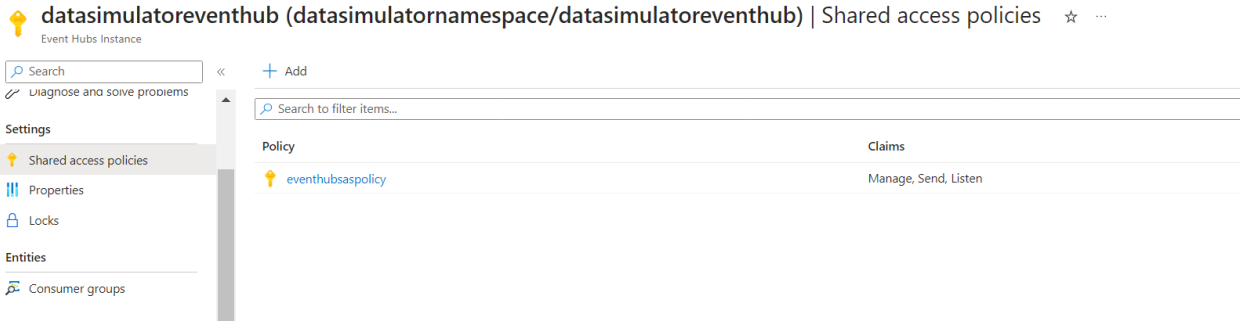
3. Create Namespace and and EventHub

- If you know the fundamentals of Kafka,
  - namespace → Broker
  - eventhub → Topic
- Try to select the location which is near to you.

- We will confront an option called capture while creating eventhub, which is used to load data into blob or ADLS directly from the eventhub.
- To use capture we have to upgrade our plan to standard or premium.



- Create an eventhub.
- We can have multiple event hubs.
- To access the eventhub from our python code. We need create a shared access policy for the eventhub.
- Click on eventhub. Go to shared access policy and create a new policy by ticking manage check box.
- Here we can get the connection string.

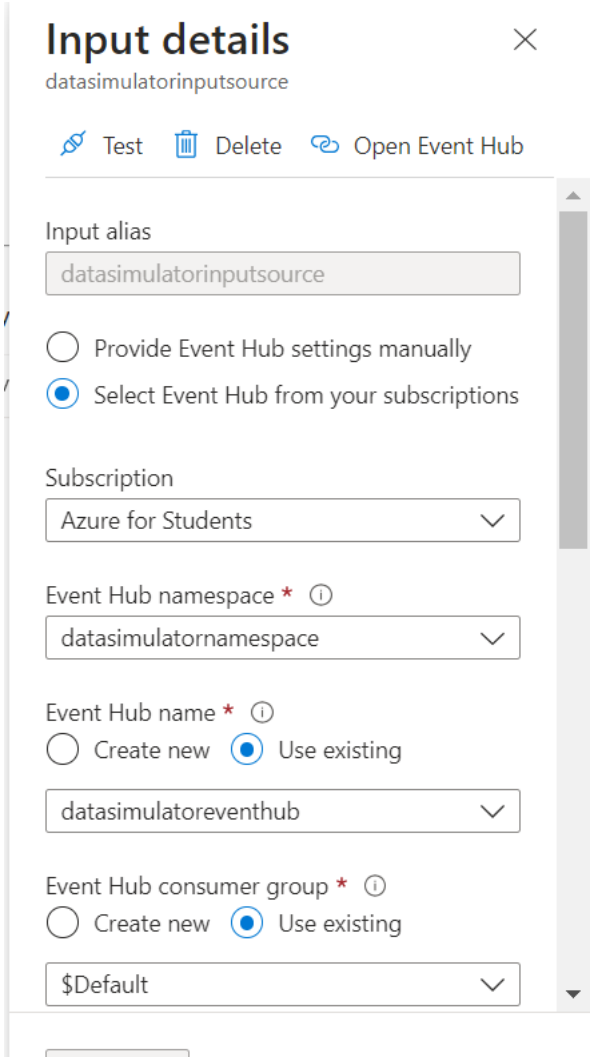


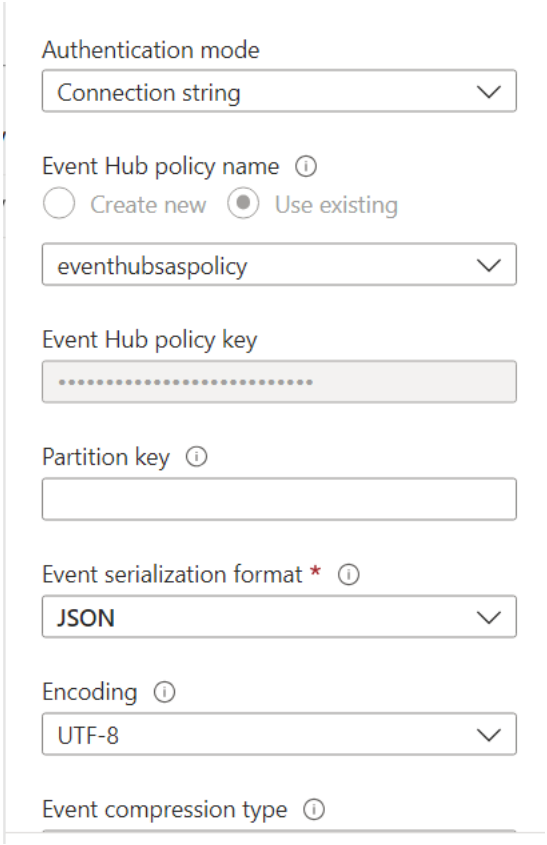
4. Create Stream analytics job

- While creating new analytics job, make use you choose the same region as your namespace.
- If not job will fail to pick up the streaming data.

Input source configuration

- Keep authentication mode as Connection string.
- For event hub policy use the one which we created initially.





Output source confirguration

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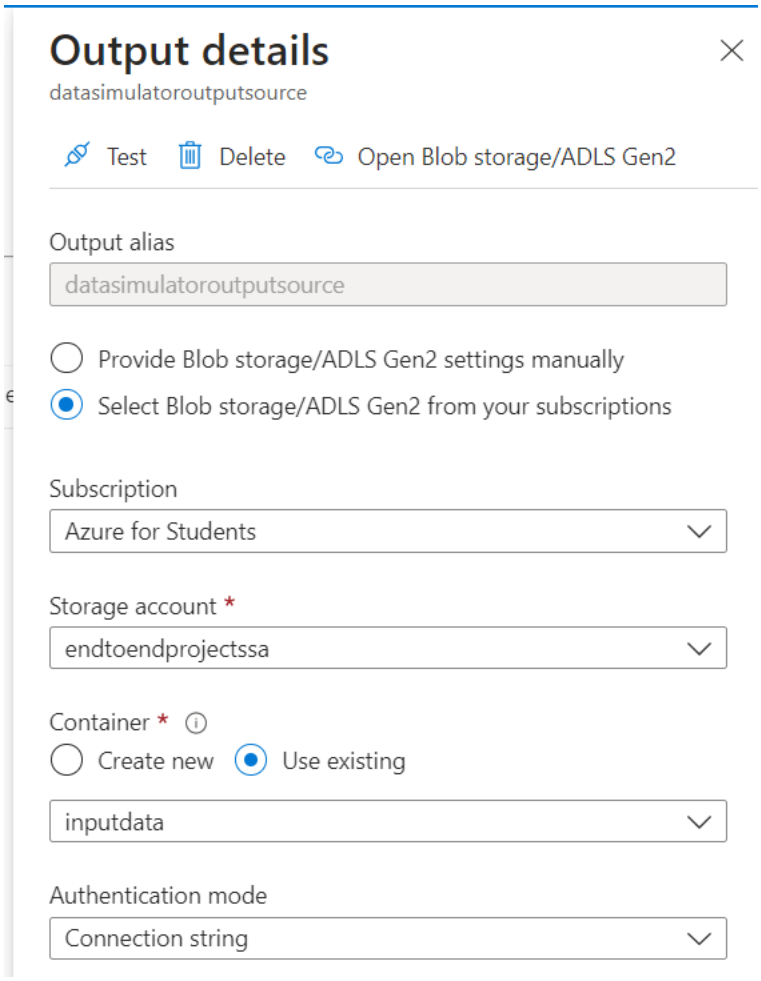
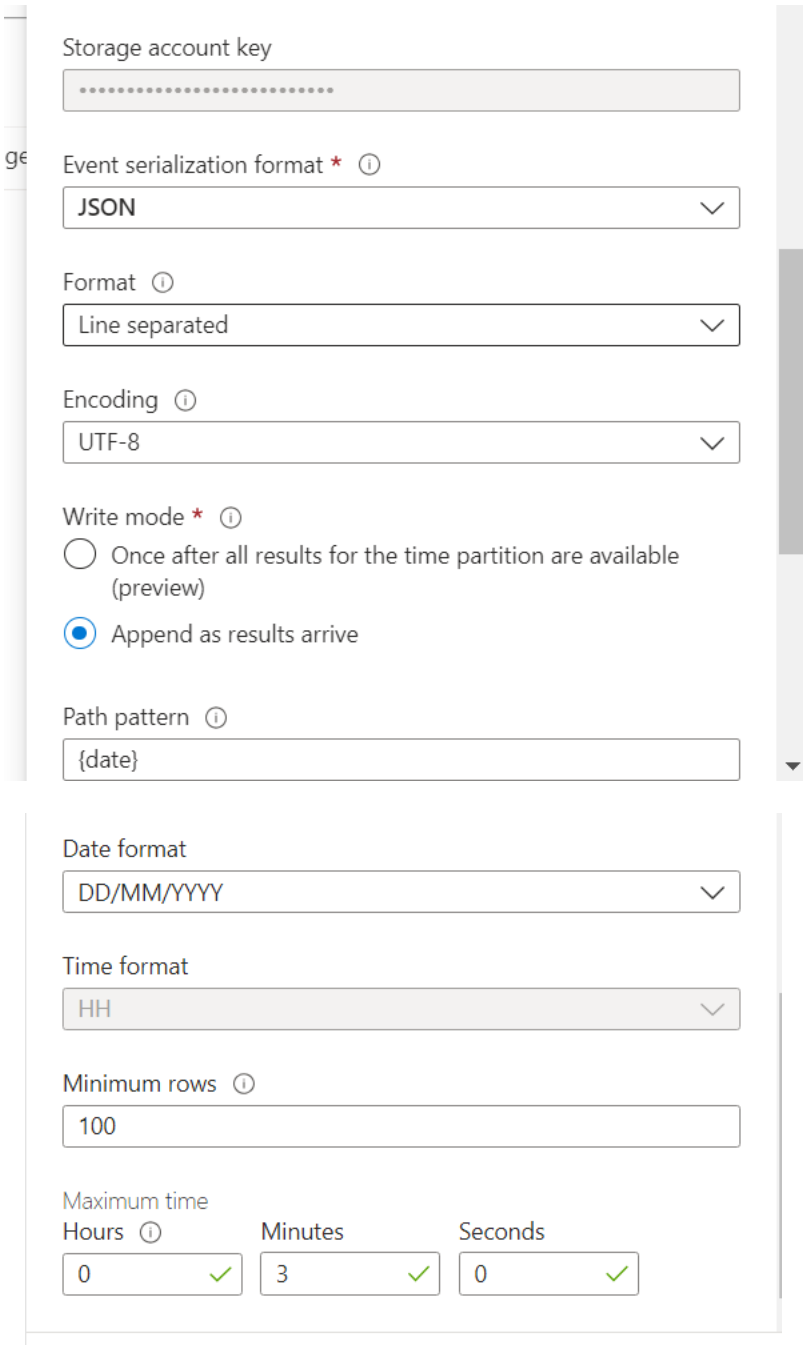
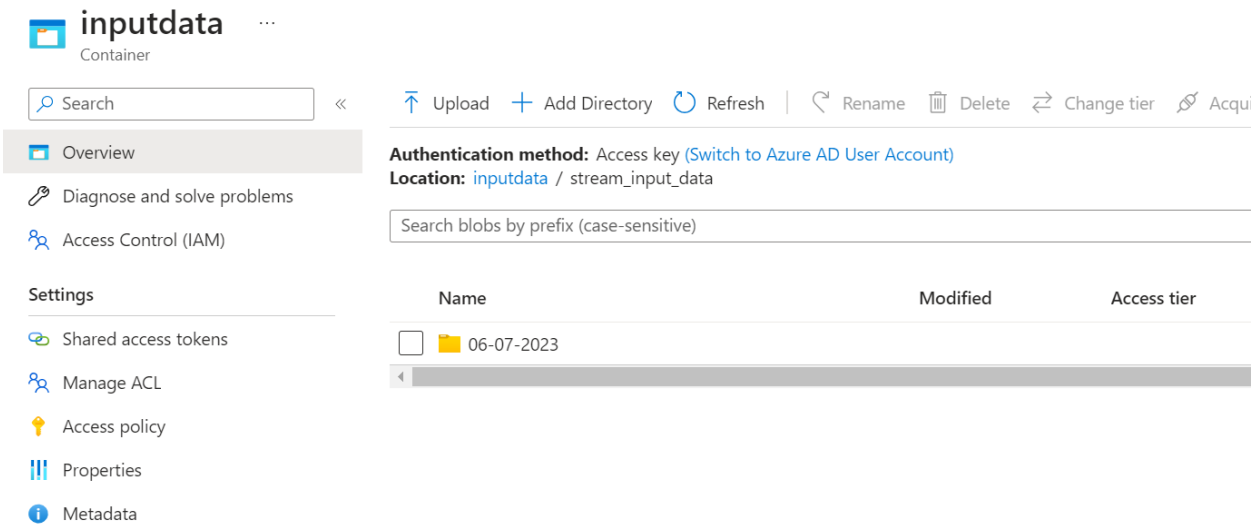

Output details
datasimulatoroutputsource
Test
Delete
Open Blob storage/ADLS Gen2
Output alias
datasimulatoroutputsource
Provide Blob storage/ADLS Gen2 settings manually
Select Blob storage/ADLS Gen2 from your subscriptions
Subscription
Azure for Students
Storage account *
endtoendprojectssa
Container *
Create new
Use existing
inputdata
Authentication mode
Connection string



5. Copy the Connection string into python code

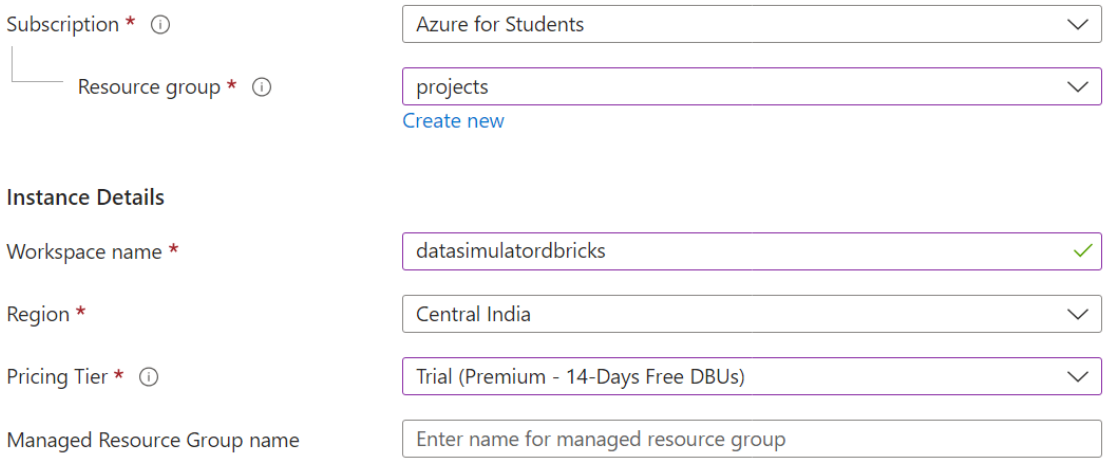
- Go to eventhub namespace
- Click on shared access policies → click on policy
- Copy the connection string primary key
- Run the python code.

- Once we start the stream analytics job. It will create folder with date as name.



Data Transformation in Azure Databricks

1.Create Azure Databricks Workspace



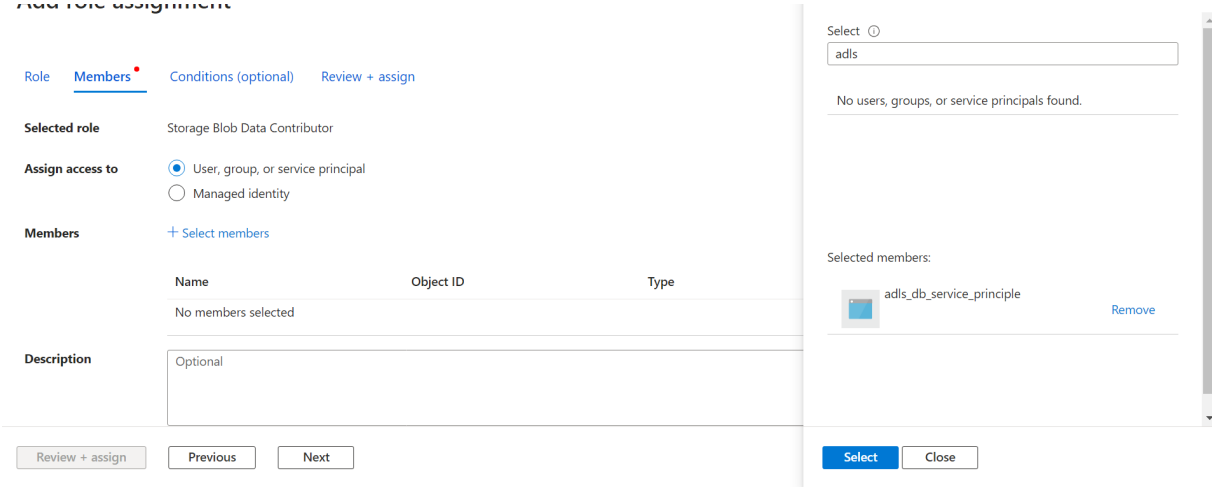
- Create a notebook and cluster
- Attach cluster to the notebook
- Mount the ADLS into notebook.
- Access key:
  - Click on storage account→ Under Security + Networking
  - Click on Access keys → Get key 1

```
'''
1.) Mount acts as a pointer to the ADLS. When we mount ADLS at some mount point
    we can access the files from ADLS as they are in databricks.
'''
dbutils.fs.mount(
    #wasbs://<container-name>@<storage-account-name>.blob.core.windows.net
```

```
    source="wasbs://inputdata@endtoendprojectssa.blob.core.windows.net",
    mount_point="/mnt/datasimulator_input_data/",
    extra_configs = {

        #Here we are connecting adls using access key
        #fs.azure.account.key.<container-name>.blob.core.windows.net : access key from the security+networking section
        #in storage account
        "fs.azure.account.key.endtoendprojectssa.blob.core.windows.net":"LpT3mcJvEYkPkVHIXsqtddddQA+gPn0DTkezIy5yeMxI+2PLgZmOX7G05DcjI//3
x+APgKKO9r6h+ASt8qJXBQ==",
    }
)

#import required modules
import datetime
from pyspark.sql.functions import to_date,from_unixtime,year,col,count,expr

'''
Since the data is available in the folder with today's date.
We have to dynamically pass the today date as folder.
'''
date = datetime.date.today().strftime("%d-%m-%Y")
path = f"/mnt/datasimulator_input_data/stream_input_data/{date}/"

#read data into data frame
bronze_data = spark.read.json(path=path)

#Convert timestamp into date and extract year from it
silver_data = bronze_data.select("ProductId","Rating","Timestamp","UserId")\
                            .withColumn("Year",year(to_date(from_unixtime(bronze_data.Timestamp))))\
                                .drop("Timestamp")

#Do group by and aggregations to get top 5 years which are getting highest 5 ratings.
gold_data = silver_data.where(expr("Rating = 5")).groupBy("Year")\
                .agg(count("Rating").alias("Total_Ratings"))\
                    .orderBy(col("Total_Ratings").desc()).limit(5)

#Since we need to visualize the data, create a delta table in default database.
gold_data.write.mode("overwrite").format("delta").saveAsTable("default.gold_table")

#Command to unmount the ADLS.
dbutils.fs.unmount("/mnt/datasimulator_input_data/")
```

Alternate way to connect ADLS to Databricks(Production level use case) using Service Principal.

- It is a more secured way to connect ADLS to Databricks.
- **Step 1:**
  - Go to Azure Active Directory → Under manage section → Click on App Registration → New Registration.
  - Give a name and keep other things default → click on Register
- **Step 2:**
  - Click on the created service principal → Go to Certificates & secrets
  - Click new client secret and make use you copy the secret value
- **Step 3:**
  - Go to Storage account → Click on Access Control (IAM)
  - Click on Add role assignment → Select Storage Blob Data Contributor
  - select your ADLS service principle.
  - Click on Review+Assign



- Step 4:
  - Create a Azure Key Vault → Under objects click on secrets.
  - Click on Generate → Add the secret value we created in step2.
- Step 5:
  - Creating a secret scope for the key in databricks
  - Add #screts/createScope at the end of the databricks url.
  - It will display an UI to create a secret scope
  - Fill th details and create a scope.

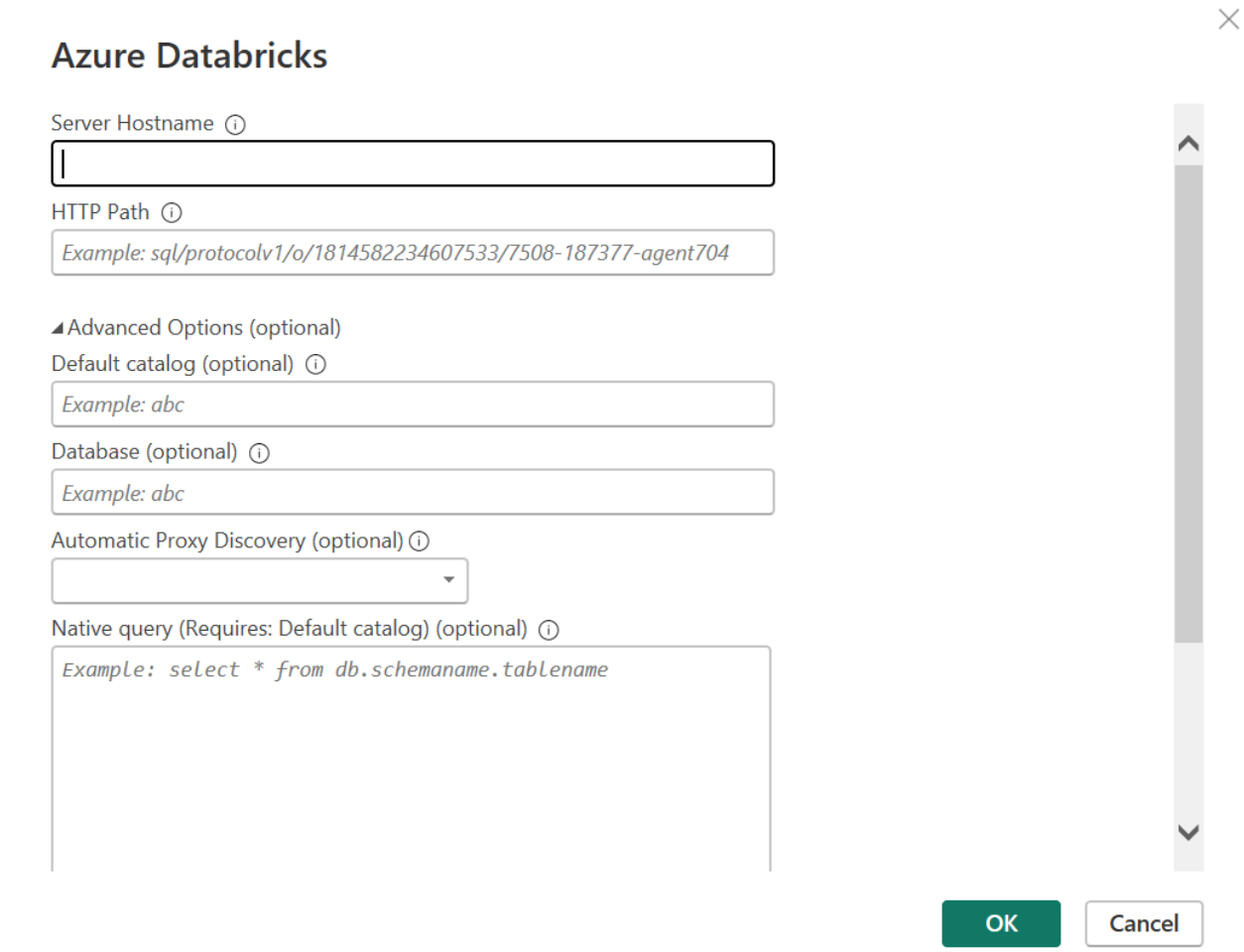
```
https://adb-6736124552009880.0.azuredatabricks.net/?o=6736124552009880#secrets/createScope
```

- Go to Databricks note book and add the below code to configure connection

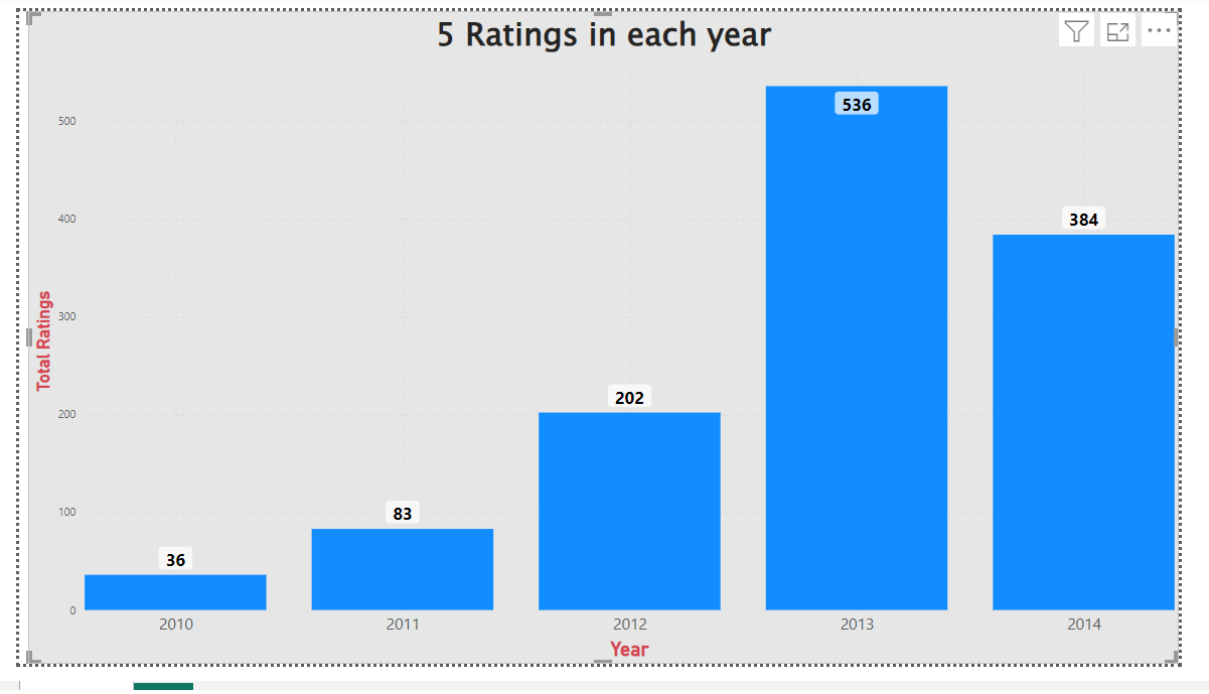
```
service_credential = dbutils.secret.get(scope="<scope-name>",key="<akv-secret-key-name>")

spark.conf.set("fs.azure.account.auth.type.<storage-account>.dfs.core.windows.net", "OAuth")
spark.conf.set("fs.azure.account.oauth.provider.type.<storage-account>.dfs.core.windows.net", "org.apache.hadoop.fs.azurebfs.oauth2.ClientCredsTokenProvider")
spark.conf.set("fs.azure.account.oauth2.client.id.<storage-account>.dfs.core.windows.net", "application-id")
spark.conf.set("fs.azure.account.oauth2.client.secret.<storage-account>.dfs.core.windows.net", service_credential)

#here directory id is id of your service principle
#Goto Azure Active Directory -> App Registrations -> Owned applications
#click on your service principle -> Directory(tenant) ID
spark.conf.set("fs.azure.account.oauth2.client.endpoint.<storage-account>.dfs.core.windows.net", "https://login.microsoftonline.com/<directory-id>/oauth2/token")

df = spark.read.csv("abfs://<container-name>@<storage-account>.dfs.core.windows.net/<path-to-file>"
```

Connecting Databricks to Power BI

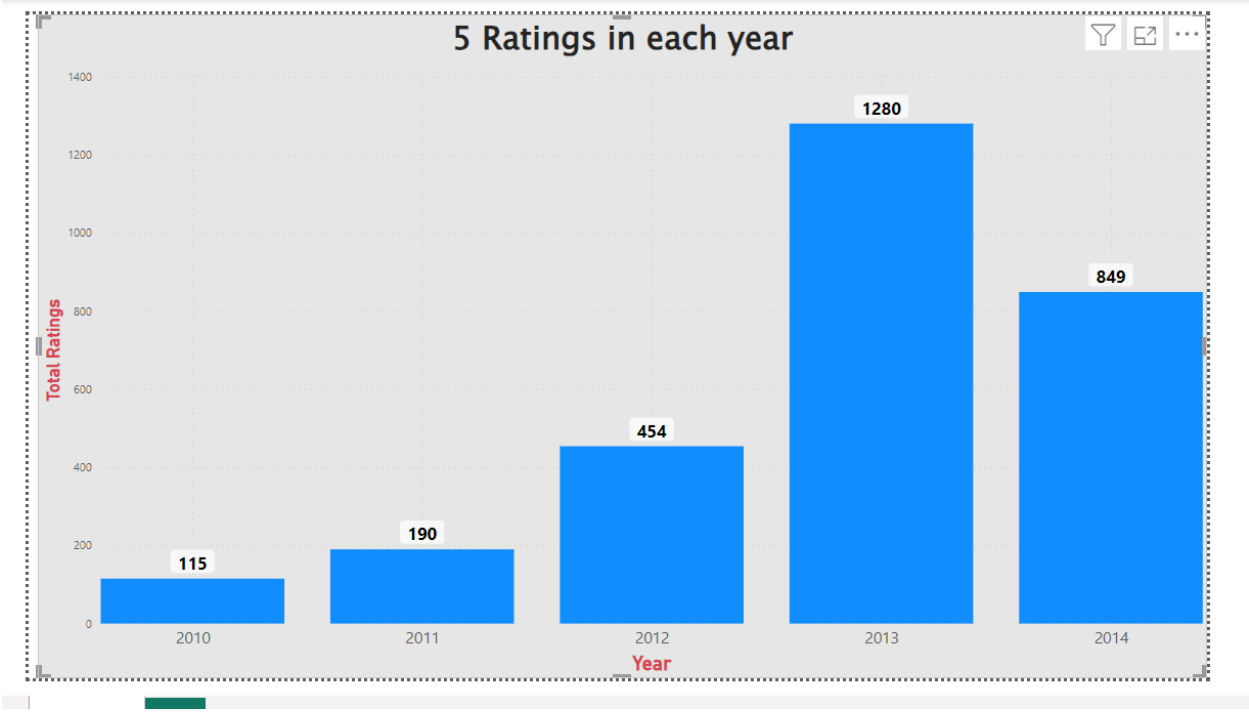
- Download the PowerBI Desktop App or we can directly use in azure as service (PowerBI Embedded)
- Under Home → Click on Get Data → Click on more
- Select Azure → Databricks



- For server Hostname and HTTP path
  - Click on compute → Click on your cluster
  - At bottom of the page under advanced options we can find these details
- Select Personal Access Token for authentication
- To create a Access Token
  - Go to Databricks notebook → Click on Azure databricks username on top right corner
  - On the **Access tokens** tab, click **Generate new token**.
  - Make sure you copy and save it some where.



- After second run, table data will be as show below.



Conclusion

- By running the notebook multiple times. We observed that Year 2013 got highest number of 5 ratings.
- Which indicates the people are happy with the products which are sold in Year 2013.