

# Streaming Data Processing

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## Project 1 :- Streaming Data Processing

### 1) Project Statement:

Set up an end-to-end pipeline with Azure Data Factory for ingesting streaming data and Azure Databricks for real-time processing and analysis of the streaming data.

### 2) Project Overview:

The primary goal of this project is to design and implement a end-to-end data pipeline using Azure Data Factory (ADF) and Azure Databricks to ingest, process, and analyse streaming data in real-time. The pipeline will enable the extraction of valuable insights from the streaming data source, providing a foundation for timely decision-making.

### 3) Project Requirements:

- a. Azure Subscription
  - ❖ You're required to have an Azure Subscription to perform this project
- b. Data Source
  - ❖ Created a python application, which fetches the weather data from the google website
- c. Azure Event Hub
  - ❖ Azure Event Hubs is a cloud-based messaging service provided by Microsoft Azure which enables large-scale, real-time event streaming for ingesting and processing data from various sources.
- d. Azure Stream Analytics
  - ❖ Azure Stream Analytics is a cloud-based service provided by Microsoft Azure that helps you analyse and gain insights from real-time data streams.
- e. Azure Data Lake
  - ❖ Azure Data Lake is like a massive storage space in the cloud where you can store and manage enormous amounts of data. It's designed to handle both large files and lots of small files

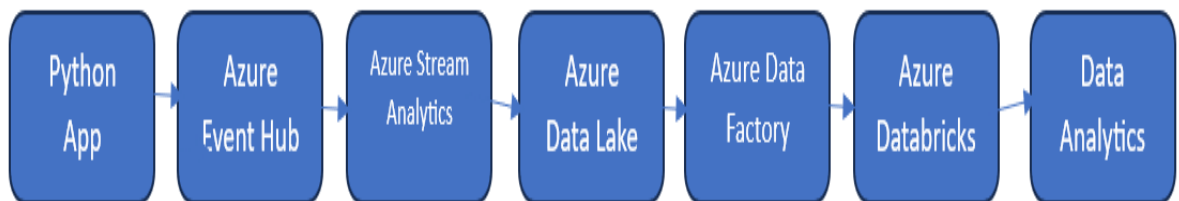
f. Azure Data Factory

- ❖ Azure Data Factory is like a digital factory that helps you collect, transform, and move your data from one place to another in a smooth and organized way.

g. Azure Databricks

- ❖ Azure Databricks is like a super-smart workspace in the cloud where you can easily analyse and process large amounts of data using Apache Spark.

#### 4) Architecture Diagram:

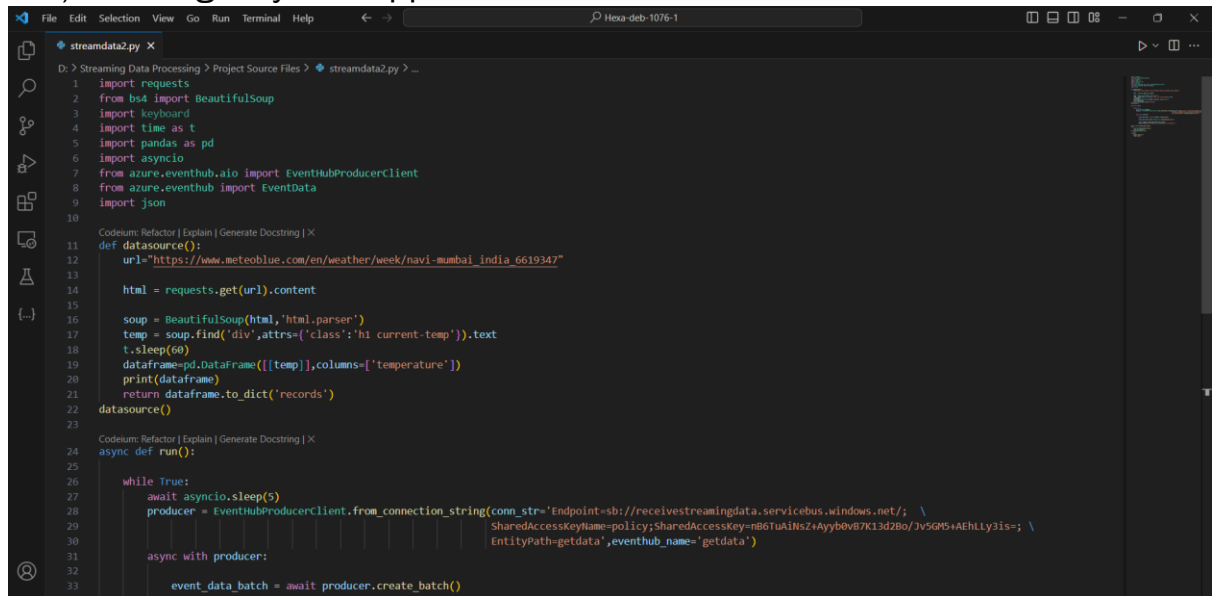


#### 5) Execution Overview:

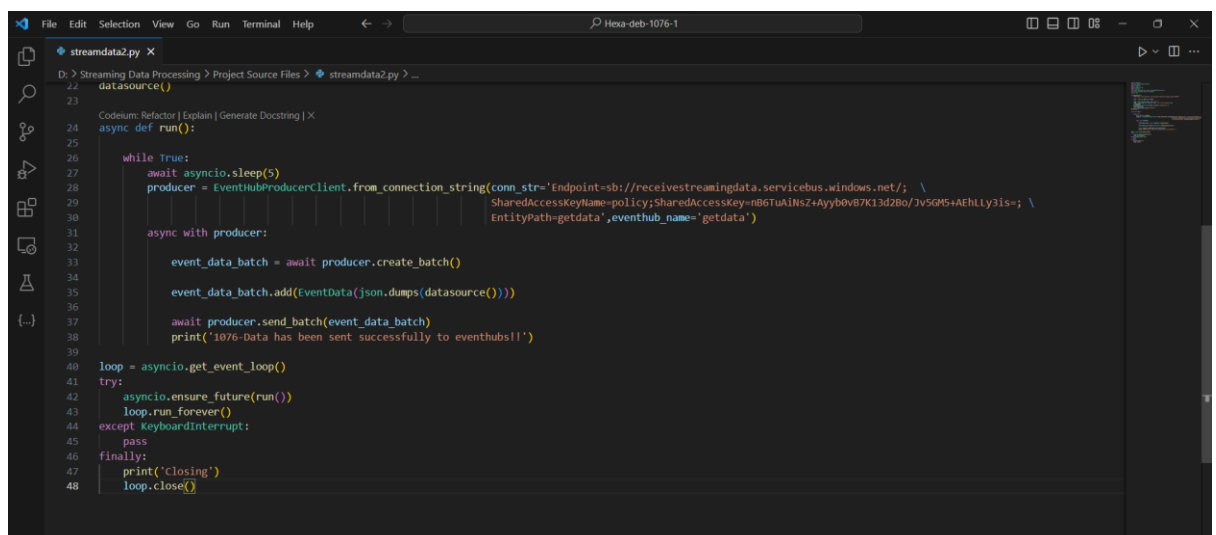
- Creating a python application which fetch a stream data from the webpages
- Connecting the Python application with the Azure Event Hub and receive the streaming data
- Use of Azure Stream Analytics to process the streaming data for storage
- Creating an Azure Data Lake Storage Gen2 to store the received data which is in **JSON** format
- Creating Data Factory for Sink Data storage
- Download and upload the **JSON** file into Azure Databricks
- Use Spark commands to perform data analysis on the **CSV** file

## 6) Project Implementation

### 6.1) Creating a Python application



```
1 import requests
2 from bs4 import BeautifulSoup
3 import keyboard
4 import time as t
5 import pandas as pd
6 import asyncio
7 from azure.eventhub.aio import EventHubProducerClient
8 from azure.eventhub import EventData
9 import json
10
11 def datasource():
12     url="https://www.meteoblue.com/en/weather/week/navi-mumbai_india_6619347"
13
14     html = requests.get(url).content
15
16     soup = BeautifulSoup(html,'html.parser')
17     temp = soup.find('div',attrs={'class':'h1 current-temp'}).text
18     t.sleep(60)
19     dataframe=pd.DataFrame([[temp]],columns=['temperature'])
20     print(dataframe)
21     return dataframe.to_dict('records')
22
23
24 async def run():
25
26     while True:
27         await asyncio.sleep(5)
28         producer = EventHubProducerClient.from_connection_string(conn_str='Endpoint=sb://receivestreamingdata.servicebus.windows.net/; \
29             SharedAccessKeyName=policy;SharedAccessKey=n86TuA1nsZ+Ayyb8v87K13d2Bo/Jv5GM5+AEhLLY3is; \
30             EntityPath=getdata',eventhub_name='getdata')
31
32         async with producer:
33             event_data_batch = await producer.create_batch()
```



```
34
35     event_data_batch.add(EventData(json.dumps(datasource()))))
36
37     await producer.send_batch(event_data_batch)
38     print('1076-Data has been sent successfully to eventhubs!!')
39
40 loop = asyncio.get_event_loop()
41 try:
42     asyncio.ensure_future(run())
43     loop.run_forever()
44 except KeyboardInterrupt:
45     pass
46 finally:
47     print('Closing')
48     loop.close()
```

## 6.2) Creating an Event Hub Namespace

The screenshot shows the 'Create Namespace' page in the Microsoft Azure portal. The page is divided into sections: 'Project Details' and 'Instance Details'. In the 'Project Details' section, the 'Subscription' is set to 'Azure subscription 1' and the 'Resource group' is 'rg-azuser1076\_mml.local-di1ea'. In the 'Instance Details' section, the 'Namespace name' is 'Receivestreamingdata' and the 'Location' is 'Central India'. The page includes a 'Review + create' button and a 'Next: Advanced >' button.

Microsoft Azure

Home > Event Hubs >

### Create Namespace

Event Hubs

Basics Advanced Networking Tags Review + create

**Project Details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \* Azure subscription 1

Resource group \* rg-azuser1076\_mml.local-di1ea

Create new

**Instance Details**

Enter required settings for this namespace, including a price tier and configuring the number of units (capacity).

Namespace name \* Receivestreamingdata

Location \* Central India

The region selected supports Availability zones. Your namespace will have Availability Zones enabled. [Learn more.](#)

Review + create < Previous Next: Advanced >

Output :

The screenshot shows the 'Overview' page for the 'Receivestreamingdata' Event Hub Namespace. The page displays various details about the namespace, including its resource group, status, location, subscription, and configuration. It also includes a 'Tags' section and a 'Show data for the last' section with a time range selector. The 'Show data for the last' section displays three charts: 'Requests', 'Messages', and 'Throughput'.

Microsoft Azure

Home > Receivestreamingdata | Overview >

### Receivestreamingdata

Event Hubs Namespace

Search

+ Event Hub Delete Refresh Give feedback

You can start generating test data with the new Azure Event Hubs Data Generator. Click on this message to try the feature!

**Essentials**

Resource group (move) : rg-azuser1076\_mml.local-di1ea

Status : Active

Location : Central India

Subscription (move) : Azure subscription 1

Subscription ID : 984f097c-963c-4eb6-a20d-839457ae9f08

Host name : Receivestreamingdata.servicebus.windows.net

Created : Saturday, 24 February 2024 at 9:57:45 GMT+5:30

Updated : Saturday, 24 February 2024 at 9:58:13 GMT+5:30

Zone Redundancy : Enabled

Pricing tier : Basic

Throughput Units : 1 unit

Auto-inflate throughput ... : Not Supported

Local Authentication : Enabled

Tags (edit) : Add tags

NAMESPACE CONTENTS 0 EVENT HUBS

KAFKA SURFACE NOT SUPPORTED

ZONE REDUNDANCY ENABLED

Show data for the last: 1 hour 6 hours 12 hours 1 day 7 days 30 days

**Requests**

**Messages**

**Throughput**

# Creating an Event Hub to receive the streaming data

Microsoft Azure Search resources, services, and docs (G+/)

Home > Receivestreamingdata | Overview > Receivestreamingdata >

## Create Event Hub

Event Hubs

Basics Capture Review + create

### Event Hub Details

Enter required settings for this event hub, including partition count and message retention.

Name \*

Partition count

### Retention

Configure retention settings for this Event Hub. [Learn more](#)

Cleanup policy

Retention time (hrs) \*  min. 1 hour, max. 24 hours (1day)

[Review + create](#) < Previous Next: Capture >

## Output:

Microsoft Azure Search resources, services, and docs (G+/)

Home > Receivestreamingdata | Overview > Receivestreamingdata >

## getdata (Receivestreamingdata/getdata)

Event Hubs Instance

Search < + Consumer group Delete Refresh Give feedback

Overview

- Access control (IAM)
- Diagnose and solve problems
- Settings
  - Shared access policies
  - Configuration
  - Properties
  - Locks
- Entities
  - Consumer groups
- Features
  - Capture
  - Generate data (preview)
  - Process data
  - Analyze data (preview)

You can start generating test data with the new Azure Event Hubs Data Generator. Click on this message to try the feature!

### Essentials

Status : Active

Resource group (move) : rg-azuser1076\_mml.local-dl1ea

Location : Central India

Subscription (move) : Azure subscription\_1

Subscription ID : 984f097c-963c-4eb6-a20d-839457ae9f08

Partition count : 1

Namespace : Receivestreamingdata

Created : Saturday, 24 February 2024 at 10:00:41 GMT+5:30

Updated : Saturday, 24 February 2024 at 10:00:41 GMT+5:30

Cleanup policy : Delete

JSON View

**Capture events**  
Use Capture to save your events to persistent storage.

**Process data**  
Process data instantly with Azure Stream Analytics.

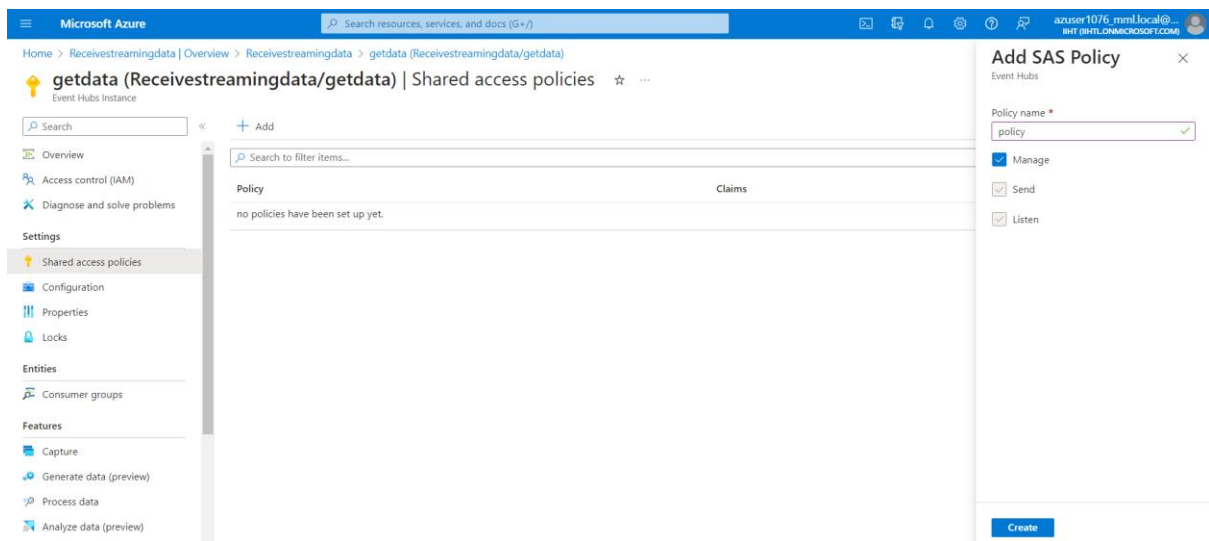
**Connect**  
Authenticate with connection strings and SAS policies.

**Checkpoint**  
Create consumer groups to checkpoint your events.

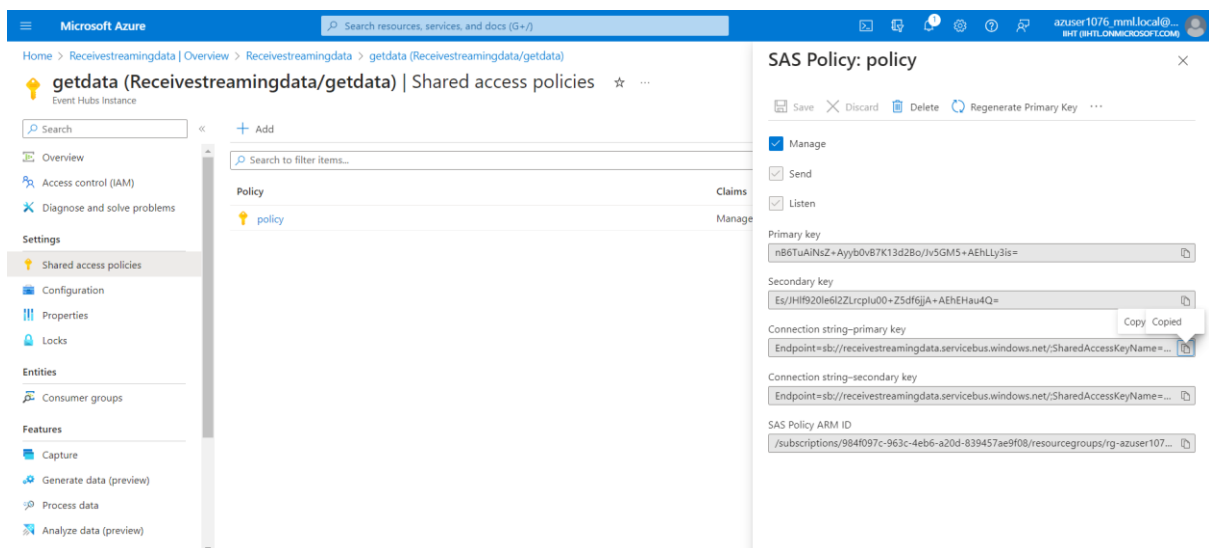
**Generate data (preview)**  
Emit data to your event hub just with a few clicks.

**Analyze data (preview)**  
Ingest to Data Explorer for near real-time analysis.

## Creating a policy in the created Event Hub



After creating the policy, copy the connection string primary-key and paste that in the python application to establish the connection





## 6.3) Creating an Azure Stream Analytics Job

The screenshot shows the 'New Stream Analytics job' form in the Microsoft Azure portal. The form is divided into three tabs: 'Basics', 'Storage', and 'Tags'. The 'Basics' tab is active. The form contains the following fields:

- Subscription \***: Azure subscription 1
- Resource group \***: rg-azuser1076\_mmllocal-di1ea
- Instance details**
  - Name \***: streamdata
  - Region \***: (Asia Pacific) Central India

At the bottom of the form, there are three buttons: 'Previous', 'Next', and 'Review + create'. A 'Give feedback' link is also present in the bottom right corner.

## Output:

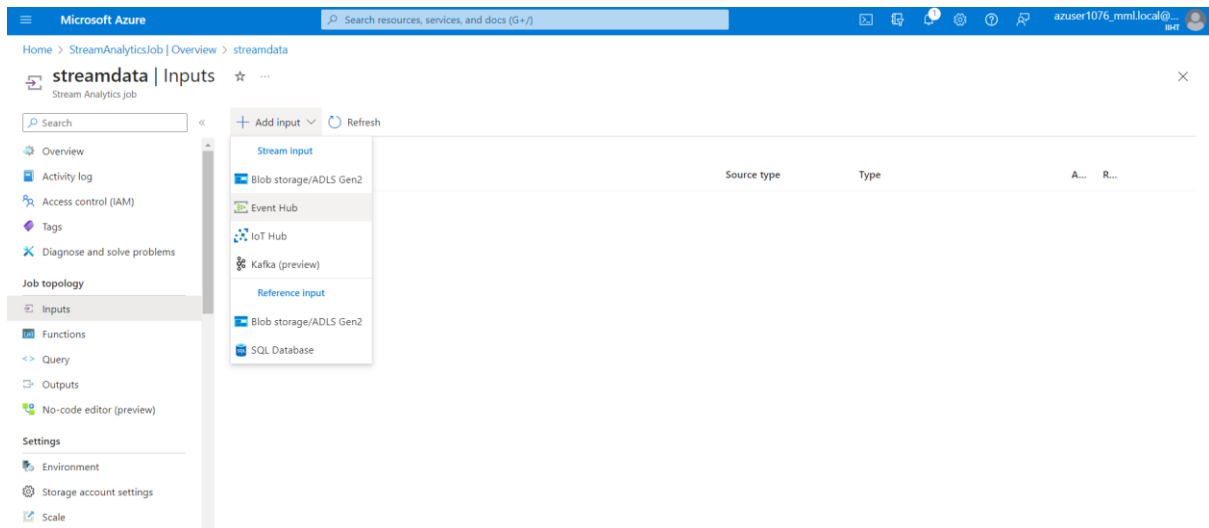
The screenshot shows the 'streamdata' job overview page in the Microsoft Azure portal. The page is divided into two main sections: 'Overview' and 'Job topology'. The 'Overview' section is active and displays the following information:

- Resource group (move)**: rg-azuser1076\_mmllocal-di1ea
- Location**: Central India
- Status**: Created
- Subscription (move)**: Azure subscription 1
- Subscription ID**: 984f097c-963c-4eb6-a20d-839457ae9f08
- Pricing plan**: StandardV2 (manage)
- Created**: Saturday, February 24, 2024 10:24 AM
- Started**:
- Output watermark**:
- Cluster**: Shared
- Hosting environment**: Cloud

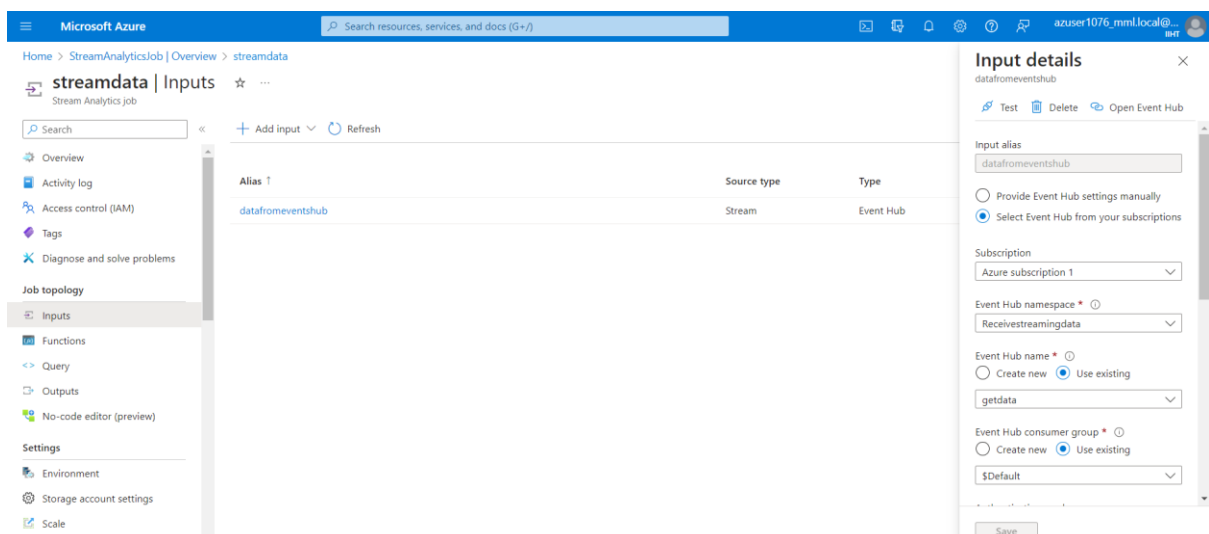
Below the overview information, there is a section titled 'Which best describes your needs?' with two options:

- I want to build my job using a query**: Represented by a blue double arrow icon (<>).
- I want to build my job without code**: Represented by a green plus icon (+).

Adding input to the Stream Analytics Job, As the data are receiving through the Event Hub so Choose select the input type as Event Hub



Enter the Event Hub Namespace name and other details in the input field



## Creating an Azure Data Lake Storage

Microsoft Azure

Search resources, services, and docs (G+/)

Home > Storage accounts >

### Create a storage account

Basics Advanced Networking Data protection Encryption Tags Review

Select the subscription in which to create the new storage account. Choose a new or existing resource group to organize and manage your storage account together with other resources.

Subscription \* Azure subscription 1

Resource group \* rg-azuser1076\_mml.local-di1ea  
[Create new](#)

**Instance details**

Storage account name \* streamingdatacontainer

Region \* (Asia Pacific) Central India  
[Deploy to an edge zone](#)

Performance \* ☒ Standard: Recommended for most scenarios (general-purpose v2 account)

[Review](#) [< Previous](#) [Next : Advanced >](#) [Give feedback](#)

## Creating an empty container to ingest the received streaming data

Microsoft Azure

Search resources, services, and docs (G+/)

Home > streamingdatacontainer

### streamingdatacontainer | Containers

Storage account

Search

+ Container Change access level Restore containers Refresh Delete Give feedback

Search containers by prefix

Name	Last modified	Anonymous
<input type="checkbox"/> \$logs	23/02/2024, 21:06:40	Private

**New container**

Name \* output

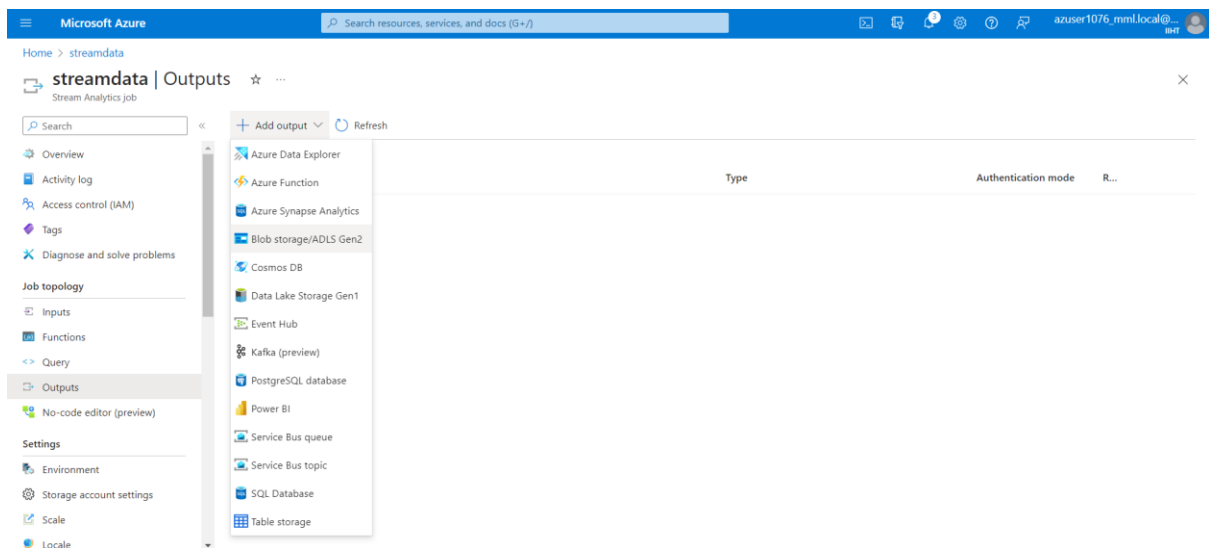
Anonymous access level ☐ Private (no anonymous access)

The access level is set to private because anonymous access is disabled on this storage account.

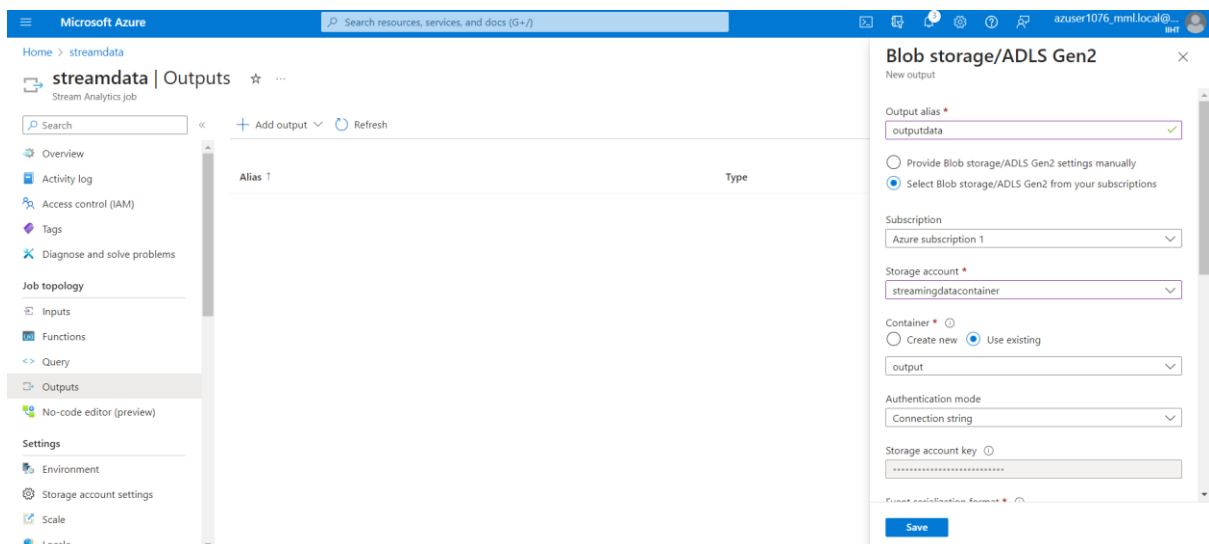
Advanced

[Create](#) [Give feedback](#)

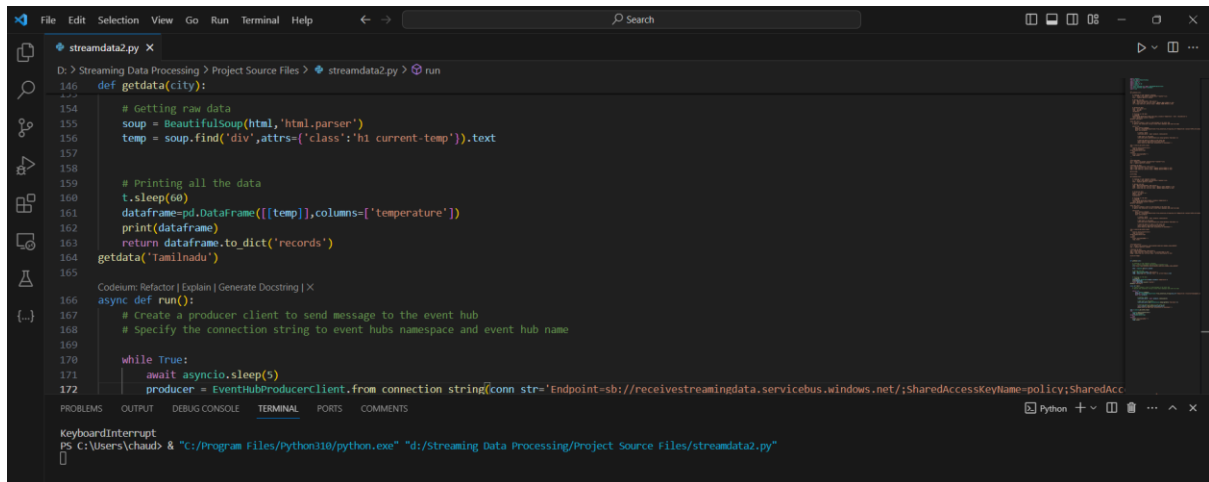
Now go to the output service in the Azure Stream Analytics Job and selecting output option as Blob Storage / ADLS Gen2



Entering the Azure Data Lake Storage name with container name and other details in the output field

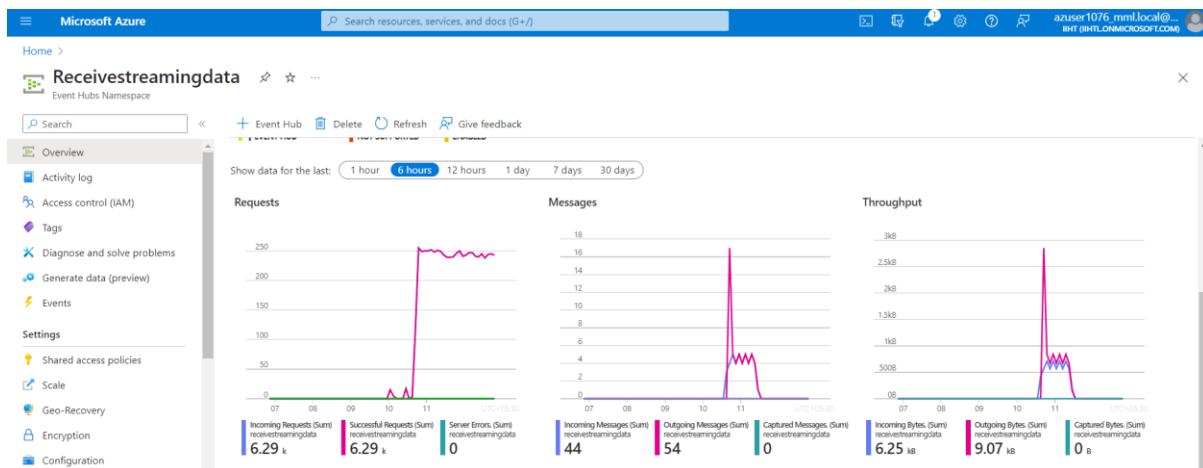


Now, running the python application start the process



```
File Edit Selection View Go Run Terminal Help
D:\Streaming Data Processing> Project Source Files > streamdata2.py > run
146 def getdata(city):
147
148     # Getting raw data
149     soup = BeautifulSoup(html, 'html.parser')
150     temp = soup.find('div', attrs={'class': 'h1 current-temp'}).text
151
152     # Printing all the data
153     t.sleep(60)
154     dataframe = pd.DataFrame([temp], columns=['temperature'])
155     print(dataframe)
156     return dataframe.to_dict('records')
157
158     getdata('Tamilnadu')
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```

This is the Event hub Metric where data is getting received:



Now, the Azure Stream Analytics Job and start the job

Microsoft Azure portal showing the 'streamdata' Stream Analytics job. The 'Overview' tab is selected, displaying the job's properties. The 'Start job' button is visible. A 'Start job' dialog box is open on the right, showing the job's configuration and a 'Start' button.

After starting the job, refreshing the query service, now we can able to see the streaming data coming from the google webpage

Microsoft Azure

streamdata | Query

Stream Analytics job

Query can't be edited while a job is running. You can stop the job to edit the query.

```
1 /*
2 Here are links to help you get started with Stream Analytics Query Language:
3 Common query patterns - https://go.microsoft.com/fwlink/?linkID=619153
4 Query language - https://docs.microsoft.com/stream-analytics-query/query-language-elements-azure-stream-analytics
5 */
6 SELECT
7 *
8 INTO
9 [outputdata]
10 FROM
11 datafromeventshub
```

Input preview

Showing sample events from 'datafromeventshub'.

temperature	EventProcessedUtcTime	PartitionId	EventEnqueuedUtcTime
"\n 27 °C "	"2024-02-24T05:11:36.7841790Z"	0	"2024-02-24T05:06:02.9990000Z"
"\n 27 °C "	"2024-02-24T05:11:36.7841790Z"	0	"2024-02-24T05:07:09.9720000Z"

Success

## 6.4) Azure Data Lake Storage

Go to the output container where we will be able to see the JSON formatted files present in the container

Microsoft Azure

streamingdatacontainer | Containers

output

Container

Authentication method: Access key (Switch to Microsoft Entra user account)

Location: output

Search blobs by prefix (case-sensitive)

Name	Modified	Access tier	Archive status	Blob type	Size	Lease state
0_ec5229a81d746e4816b1993bf544822_1.json	24/02/2024, 10:41:37	Hot (Inferred)		Block blob	460 B	Available

## Data is present in the JSON file

The screenshot shows the Microsoft Azure portal interface. On the left, the 'output' container is selected under 'streamingdatacontainer | Containers > output'. The 'Overview' tab is active, showing the container's name, location, and authentication method. The 'Name' field displays '0\_ec5229a81df746e4816b1993bf544822\_1.json'. On the right, the 'Edit' tab is active, showing the JSON content of the blob. The JSON is a list of 18 objects, each containing 'temperature' and 'EventPr' fields.

Index	temperature	EventPr
1	27 °C	"EventPr"
2	27 °C	"EventPr"
3	27 °C	"EventPr"
4	27 °C	"EventPr"
5	29 °C	"EventPr"
6	29 °C	"EventPr"
7	29 °C	"EventPr"
8	29 °C	"EventPr"
9	29 °C	"EventPr"
10	29 °C	"EventPr"
11	29 °C	"EventPr"
12	29 °C	"EventPr"
13	29 °C	"EventPr"
14	29 °C	"EventPr"
15	29 °C	"EventPr"
16	29 °C	"EventPr"
17	29 °C	"EventPr"
18	29 °C	"EventPr"

## Creating Data Factory:

The screenshot shows the 'Create Data Factory' wizard in the Microsoft Azure portal. The 'Basics' tab is selected, showing the 'Project details' section. The 'Subscription' is set to 'Azure subscription 1' and the 'Resource group' is 'rg-azuser1076\_mml.local-di1ea'. The 'Instance details' section shows the 'Name' as 'ADF-1076', 'Region' as 'East US', and 'Version' as 'V2'. The 'Review + create' button is highlighted at the bottom.

**Project details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \*

Resource group \*

**Instance details**

Name \*

Region \*

Version \*

[Previous](#) [Next](#) [Review + create](#) [Give feedback](#)



## Selecting Source Data Storage:

Microsoft Azure | Data Factory | ADF-1076 | Search factory and documentation | azuser1076\_mmt.local@ihht.onmicrosoft.com

**Copy Data tool**

Properties  
Source  
Dataset  
Configuration  
Destination  
Settings  
Review and finish

**Source data store**  
Specify the source data store for the copy task. You can use an existing data store connection or specify a new one.

Source type: Azure Data Lake Storage Gen2

Connection: Select... + New connection

**New connection**  
Azure Data Lake Storage Gen2 [Learn more](#)

Name: AzureDataLakeStorage1

Description:

Connect via integration runtime: AutoResolveIntegrationRuntime

Authentication type: Account key

Account selection method: From Azure subscription (selected) / Enter manually

Azure subscription: Azure subscription 1 (984f097c-963c-4eb6-a20d-839457ae9f08)

Storage account name: streamingdatacontainer

Test connection: To linked service (selected) / To file path

Buttons: Create, Cancel, Test connection

## Selecting Destination Data Storage:

Microsoft Azure | Data Factory | ADF-1076 | Search factory and documentation | azuser1076\_mmt.local@ihht.onmicrosoft.com

**Copy Data tool**

Properties  
Source  
Destination  
Dataset  
Configuration  
Settings  
Review and finish

**Destination data store**  
Specify the destination data store for the copy task. You can use an existing data store connection or specify a new one.

Destination type: Azure Data Lake Storage Gen2

Connection: Select... + New connection

**New connection**  
Azure Data Lake Storage Gen2 [Learn more](#)

Name: streamingdatacsv

Description:

Connect via integration runtime: AutoResolveIntegrationRuntime

Authentication type: Account key

Account selection method: From Azure subscription (selected) / Enter manually

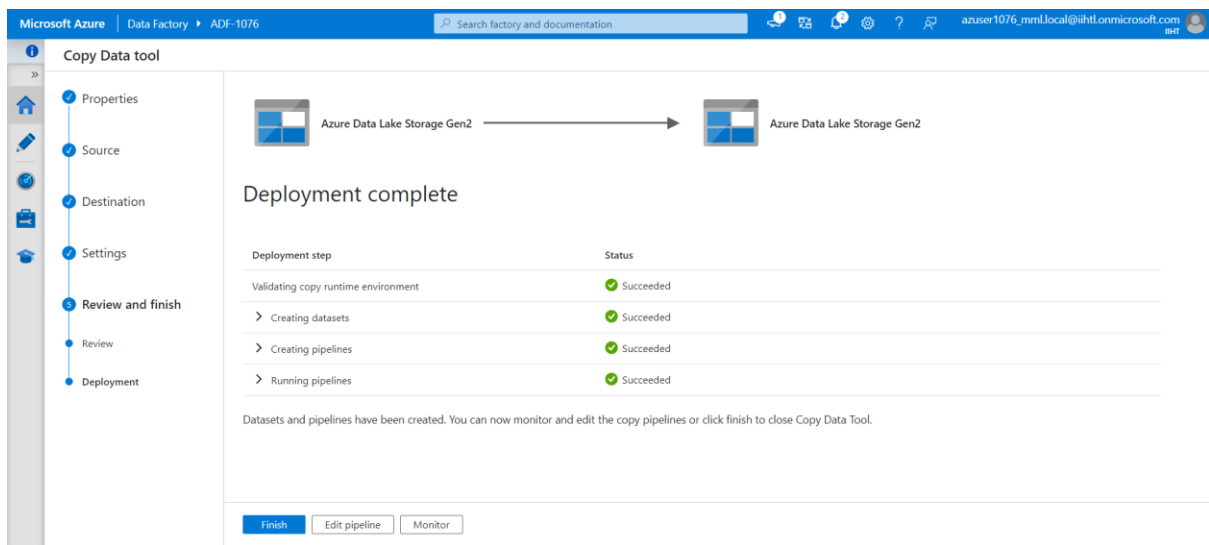
Azure subscription: Select all

Storage account name: streamingdatacsv

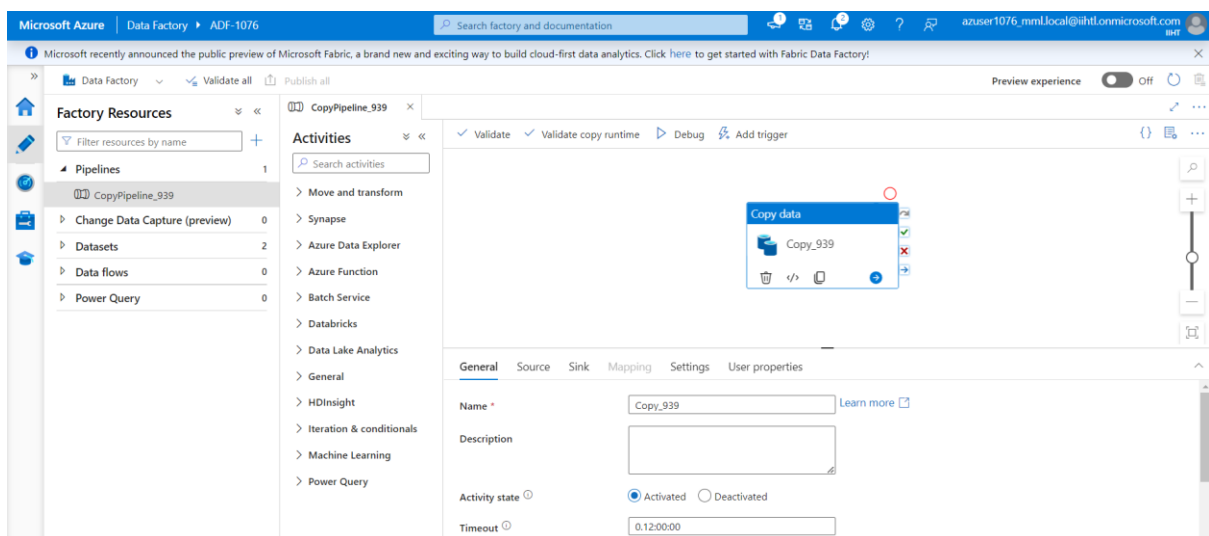
Test connection: To linked service (selected) / To file path

Buttons: Create, Cancel, Test connection

## Creating Pipeline:



## 6.5) creating a pipeline to initiate the copy activity



select debug option, after the successfully completion of the activity we can able to see the activity status as succeeded

The screenshot shows the Microsoft Azure Data Factory (ADF) interface. On the left, the 'Factory Resources' pane lists 'Pipelines' with 'CopyPipeline\_939' selected. The main canvas displays a 'Copy data' activity named 'Copy\_939' with a green checkmark indicating success. Below the canvas, the 'Output' tab shows the 'Pipeline run ID' as '55a36a93-3dd9-4078-abbe-e7168e88934f' and the 'Pipeline status' as 'In progress'. A table below lists the activity status:

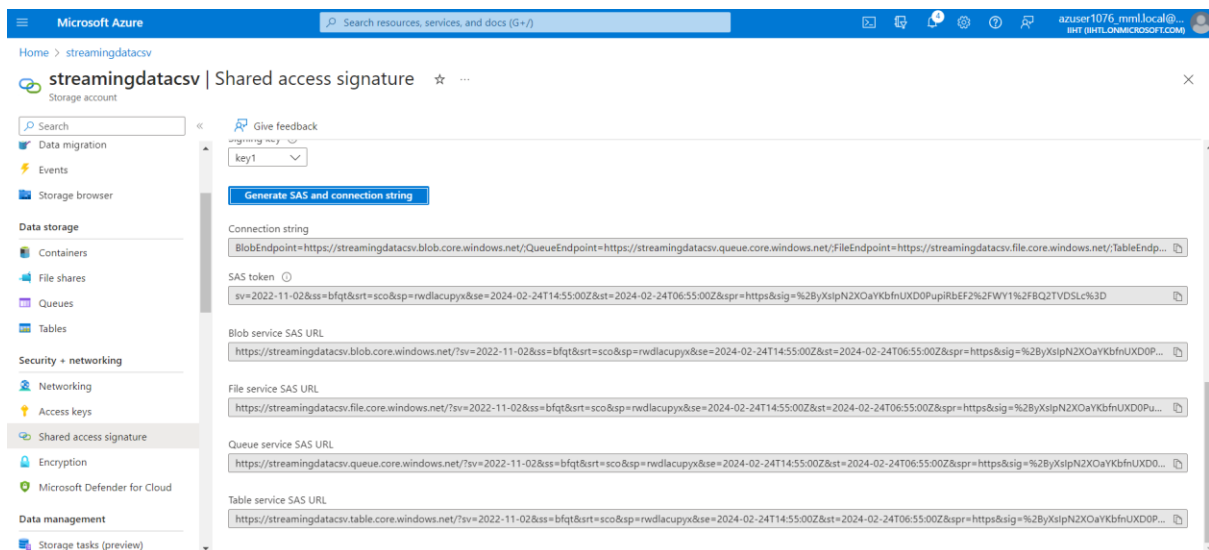
Activity name	Activity status	Activity type	Run start	Duration	Integration runtime
Copy_939	Succeeded	Copy data	2/24/2024, 11:16:40 AM	19s	AutoResolveIntegrator

Data is been updated in Sink dataset

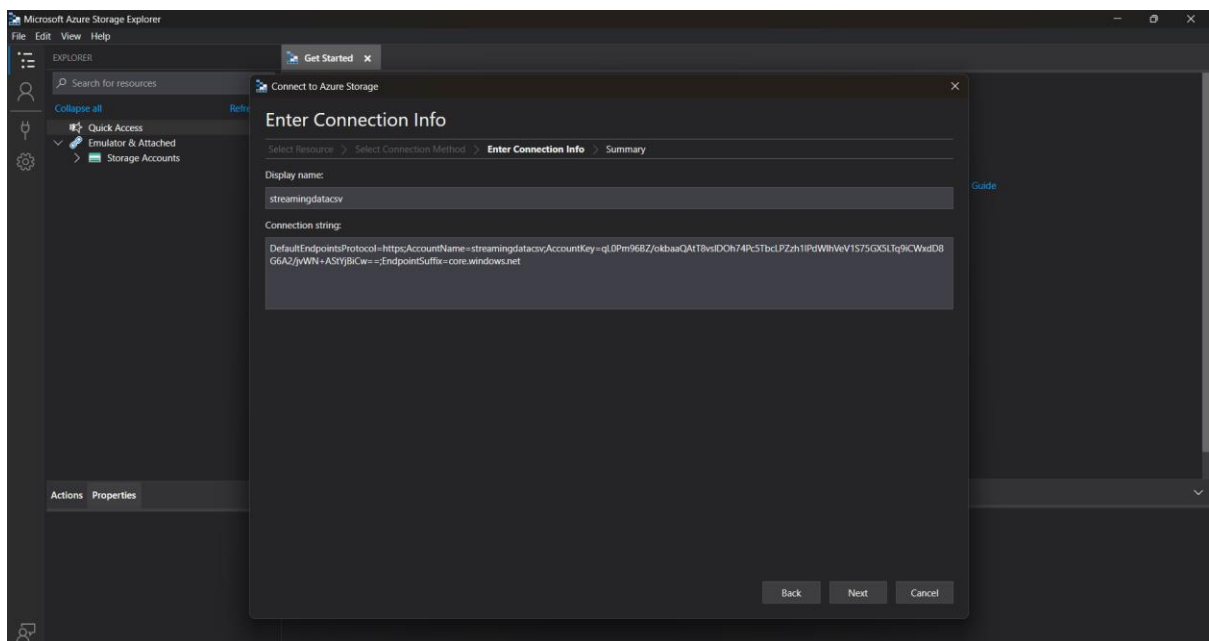
The screenshot shows the Microsoft Azure Storage Explorer interface. The left pane shows the 'outputforcsv' container. The right pane displays a table of blobs:

Name	Modified	Access tier	Archive status	Blob type	Size	Lease state
0_ec5229a81df746e4816b1993bf544822_1.json	24/02/2024, 12:17:01	Hot (Inferred)		Block blob	9.02 KIB	Available

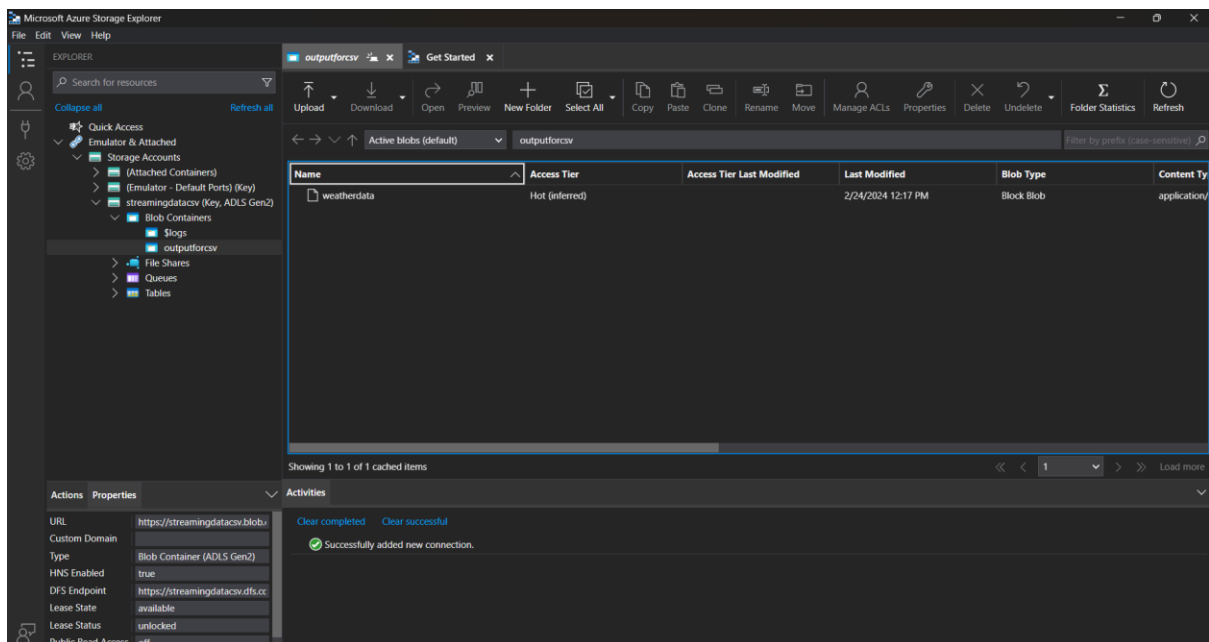
## 6.6) Generating SAS & connection string



Establishing the connection with explorer:

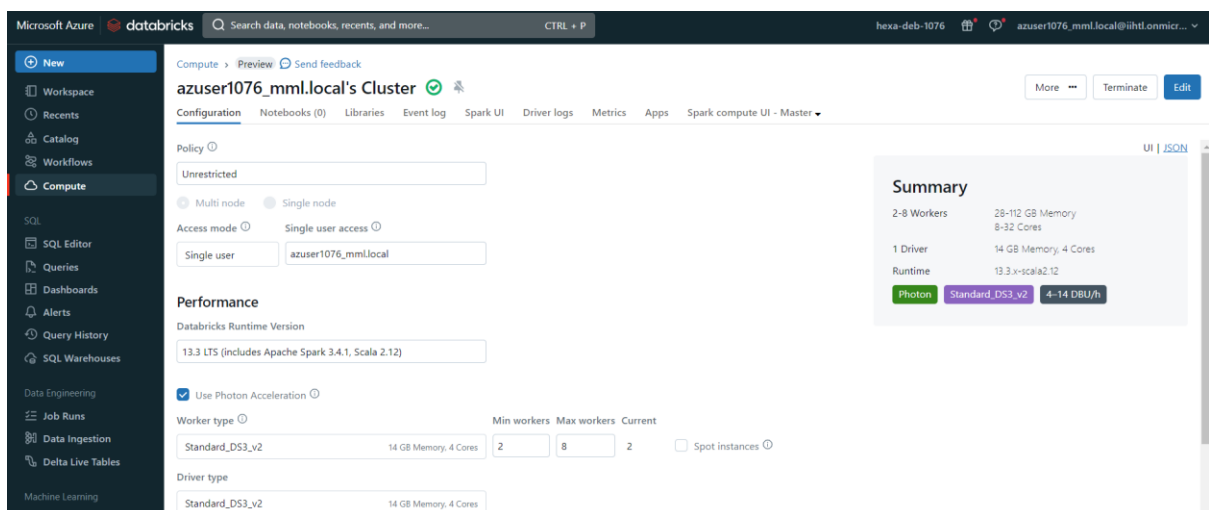


Connection was established successfully:

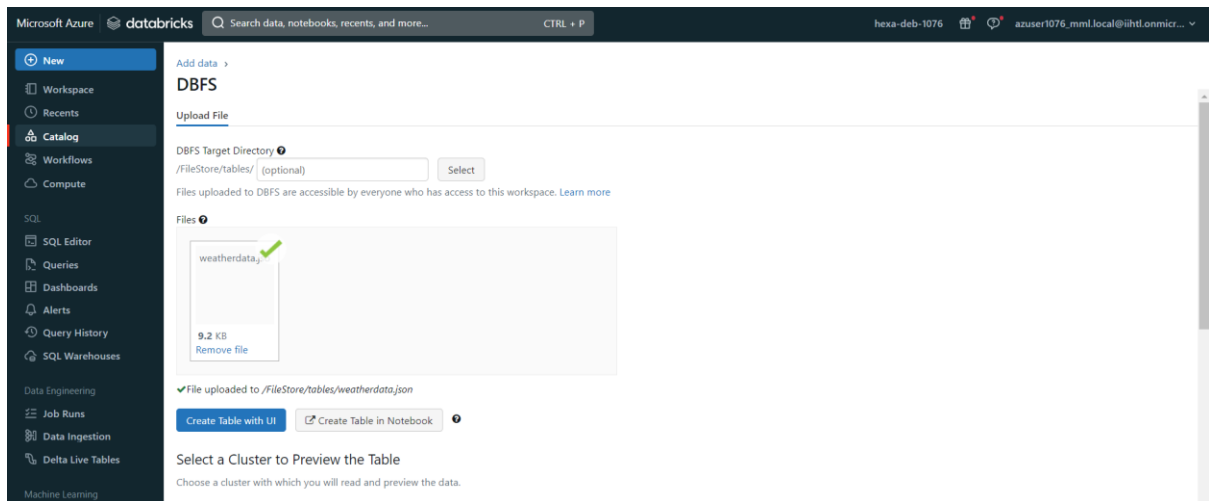


## Azure Databricks

### Creating a cluster in the Azure Databricks workspace



Then uploading the file by using create a new table option and select Create Table in Notebook



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Add data > DBFS

Upload File

DBFS Target Directory   
 /FileStore/tables/ (optional)   
 Select

Files uploaded to DBFS are accessible by everyone who has access to this workspace. Learn more

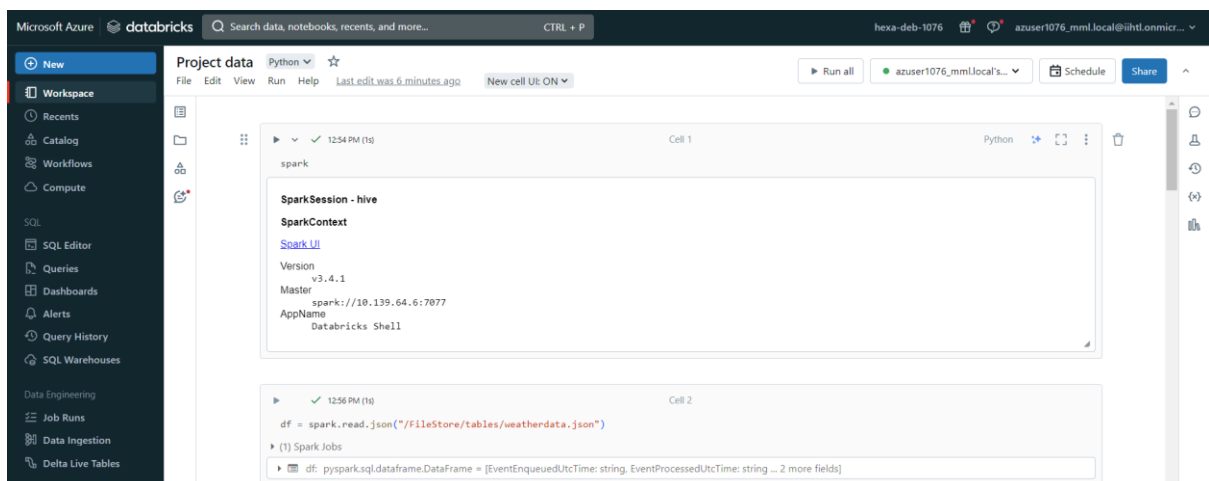
Files   
 weatherdata.json   
 9.2 KB   
 Remove file

File uploaded to /FileStore/tables/weatherdata.json

Create Table with UI Create Table in Notebook

Select a Cluster to Preview the Table   
 Choose a cluster with which you will read and preview the data.

## Analysing the uploaded data



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Project data Python Last edit was 6 minutes ago New cell UI: ON

Run all azuser1076\_mml.local's... Schedule Share

Cell 1   
 spark   
 SparkSession - hive   
 SparkContext   
 [Spark UI](#)   
 Version   
 v3.4.1   
 Master   
 spark://10.139.64.6:7077   
 AppName   
 Databricks Shell

Cell 2   
 df = spark.read.json("/FileStore/tables/weatherdata.json")   
 (1) Spark Jobs   
 df: pyspark.sql.dataframe.DataFrame = [EventEnqueuedUtcTime: string, EventProcessedUtcTime: string ... 2 more fields]



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Project data Python Last edit was 7 minutes ago New cell UI: ON

Run all azuser1076\_mml.local's... Schedule Share

Cell 4   
 df.write.option("header", "true").csv("/FileStore/tables/weatherdata1\_csv")   
 (1) Spark Jobs

Cell 5   
 df1 = spark.read.csv("/FileStore/tables/weatherdata1\_csv")   
 (1) Spark Jobs   
 df1: pyspark.sql.dataframe.DataFrame = [\_c0: string, \_c1: string ... 2 more fields]

Microsoft Azure databricks Search data, notebooks, recents, and more... CTRL + P hexa-deb-1076 azuser1076\_mml.local@iitl.onmicr...

New Workspace Recents Catalog Workflows Compute SQL SQL Editor Queries Dashboards Alerts Query History SQL Warehouses Data Engineering Job Runs Data Ingestion Delta Live Tables Machine Learning Experiments

Project data Python File Edit View Run Help Last edit was now New cell UI: ON

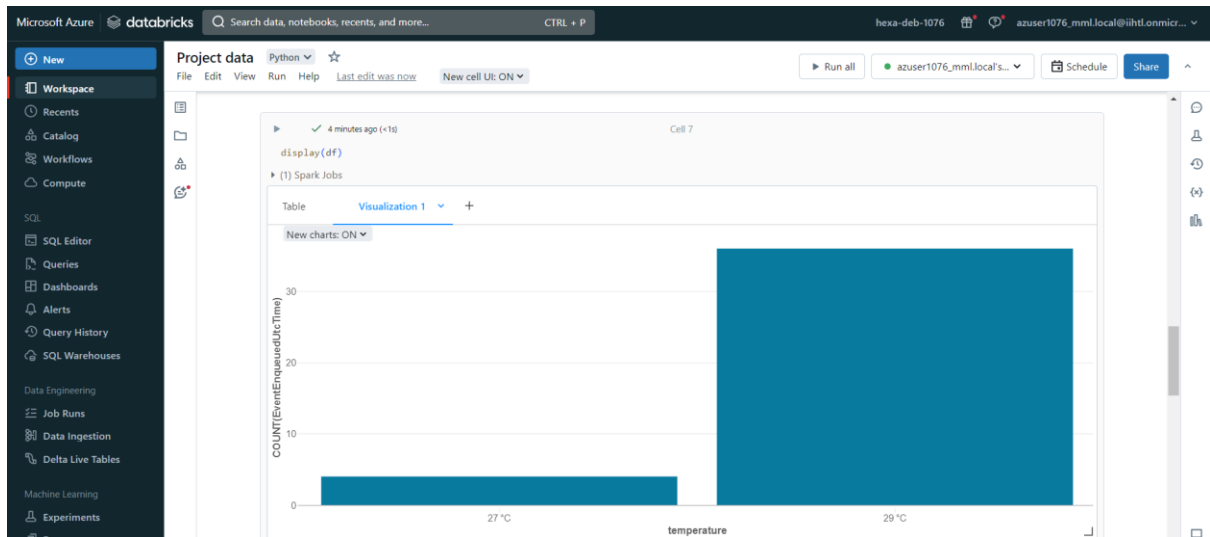
Run all azuser1076\_mml.local's... Schedule Share

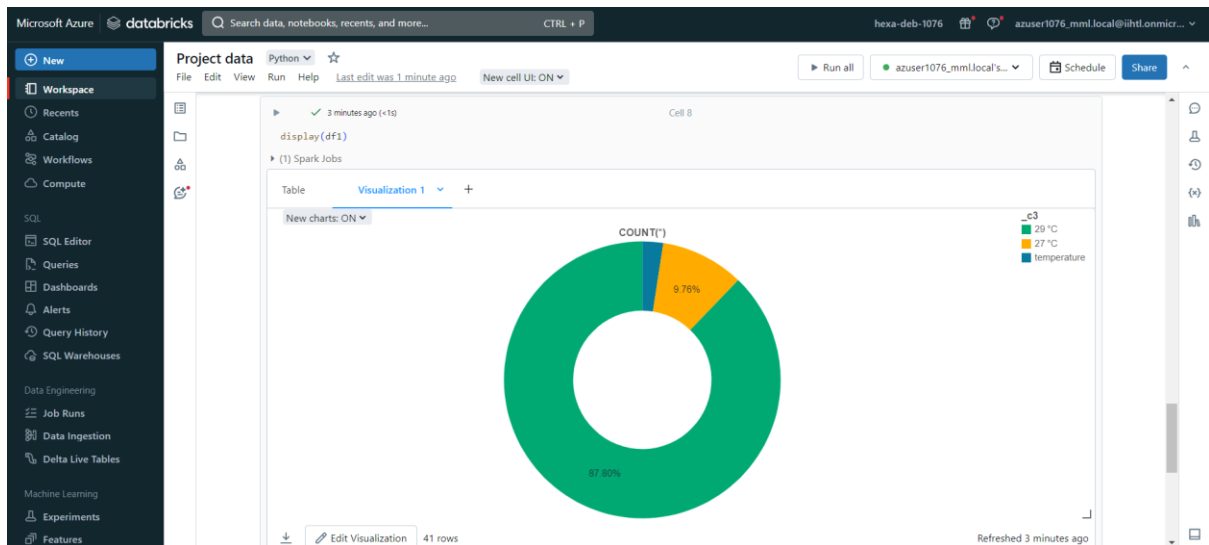
Cell 6

```
df1.show()
```

(1) Spark Jobs

EventEnqueuedUtcTime	EventProcessedUtcTime	PartitionId	temperature
2024-02-24T05:10:...	2024-02-24T05:11:...	0	27 °C
2024-02-24T05:11:...	2024-02-24T05:11:...	0	27 °C
2024-02-24T05:12:...	2024-02-24T05:12:...	0	27 °C
2024-02-24T05:13:...	2024-02-24T05:13:...	0	27 °C
2024-02-24T05:14:...	2024-02-24T05:14:...	0	29 °C
2024-02-24T05:16:...	2024-02-24T05:16:...	0	29 °C
2024-02-24T05:17:...	2024-02-24T05:17:...	0	29 °C
2024-02-24T05:18:...	2024-02-24T05:18:...	0	29 °C
2024-02-24T05:19:...	2024-02-24T05:19:...	0	29 °C
2024-02-24T05:20:...	2024-02-24T05:20:...	0	29 °C
2024-02-24T05:21:...	2024-02-24T05:21:...	0	29 °C
2024-02-24T05:22:...	2024-02-24T05:22:...	0	29 °C
2024-02-24T05:23:...	2024-02-24T05:23:...	0	29 °C
2024-02-24T05:24:...	2024-02-24T05:24:...	0	29 °C
2024-02-24T05:26:...	2024-02-24T05:26:...	0	29 °C
2024-02-24T05:27:...	2024-02-24T05:27:...	0	29 °C
2024-02-24T05:28:...	2024-02-24T05:28:...	0	29 °C





## 7) Conclusion:

Setting up an end-to-end pipeline with Azure Data Factory for ingesting streaming data and Azure Databricks for real-time processing and analysis is a powerful approach for handling streaming data workflows. This setup allows you to efficiently ingest, process, and analyze data in real time, enabling you to derive valuable insights and make timely decisions. The flexibility and scalability of these Azure services enable you to adapt to changing data requirements and scale your pipeline as your data volume grows. Overall, this combination of Azure Data Factory and Azure Databricks provides a reliable and efficient solution for handling streaming data processing tasks.