ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS
BUSINESS ANALYTICS Master of Science

Modern Data Management & Business Intelligence

Assignment #3: ATM Data Streams

Tutor: Chatziantoniou Damianos

Students

Despotis Spyridon: p2822111

Papailiou Thanasis: p2822128

2022

Contents

1. Introduction

Nowadays, event processing engines are becoming more and more popular due to their effectiveness in capturing and analysing complex streams of data with automatic actions. Specifically, in Banking sector event processing engines, can provide numerous opportunities for stronger risk management and empower intelligent banking. For example, in Greece during the year of 2021, the Greek National Bank utilized SAS Viya through Microsoft Azure in order to adopt advanced analytics and modernize and improve its profitability.

In this assignment we wanted to explore further the capabilities and the variety of elements of Azure Stream Analytics Platform. The given reference data files, contain data related to transactions in ATM machines. This report is presenting all the process we followed of setting up the account and executing queries to ensure that our flow is working property.

Reference Data	*Explanation*
AREA.json	Geographical Information / Connects each area_code with a city and a country / The "area_code" of this dataset can be joined with the "area_code" of ATM.json
ATM.json	Information about the ATM / Connects each ATM with an area / The "atm_code" of this dataset can be joined with the input's "ATMCode" section
Customer.json	Information about each customer / Provides demographic information about each customer / The "card_number" of this dataset can be joined with the input's "CardNumber" section.

Table 1-1 Reference Data Explanation

2. Process of setting up Azure Analytics Stream Flow

Firstly, we will create a **student account** in to **Azure Analytics Platform** with our university emails (AUEB).

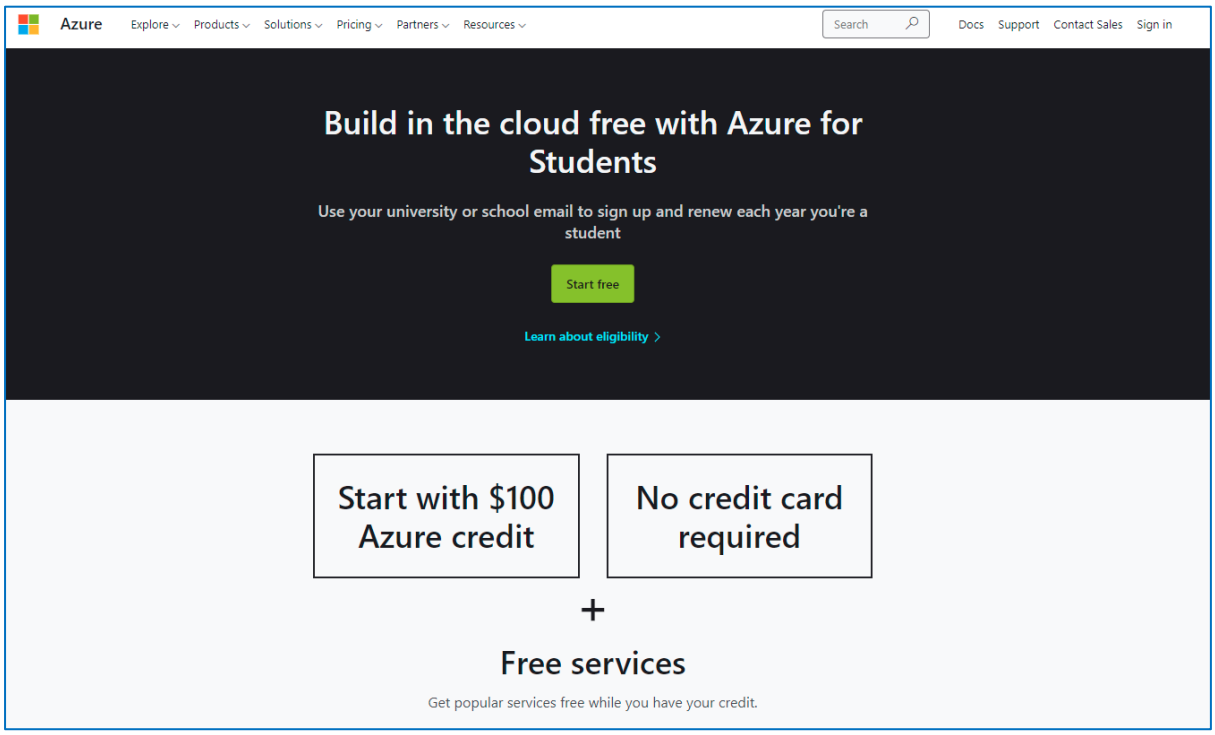

Figure 2-1 Microsoft Azure Sign Up Page for Students

Secondly, we will build a **Namespace** for our project, with the following details:

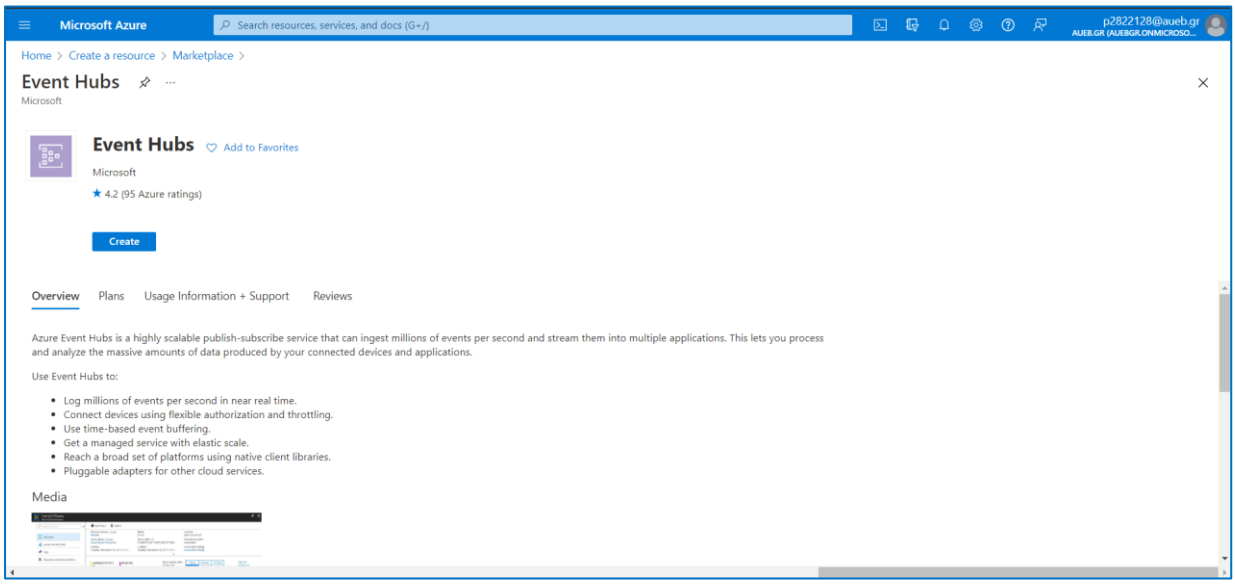

Figure 2-2 Event Hubs Service in Azure Marketplace

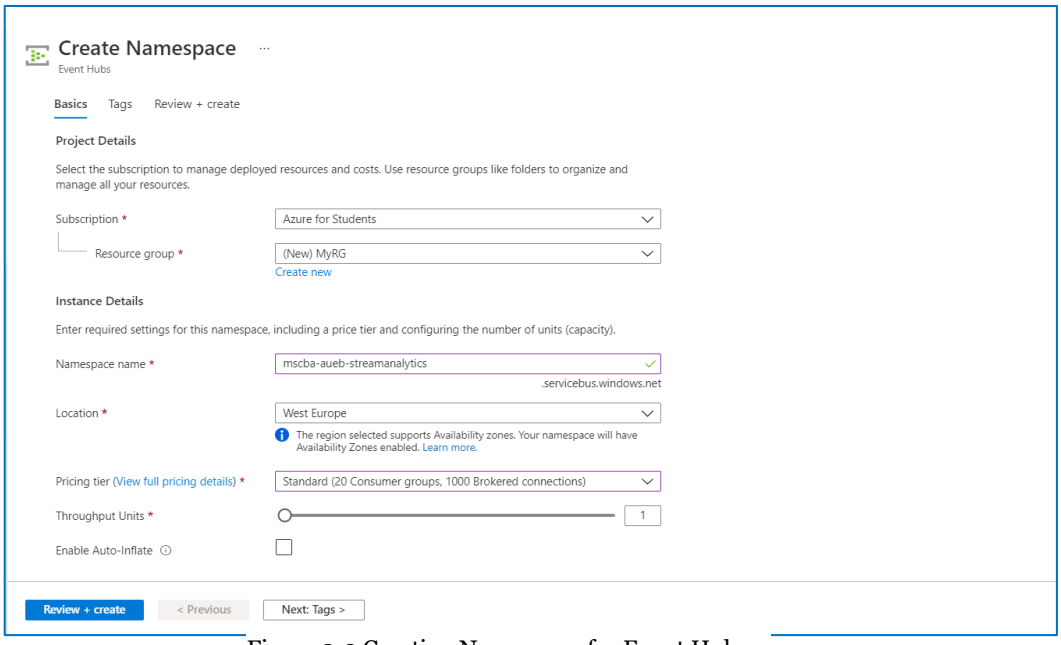

Figure 2-3 Creating Namespace for Event Hubs

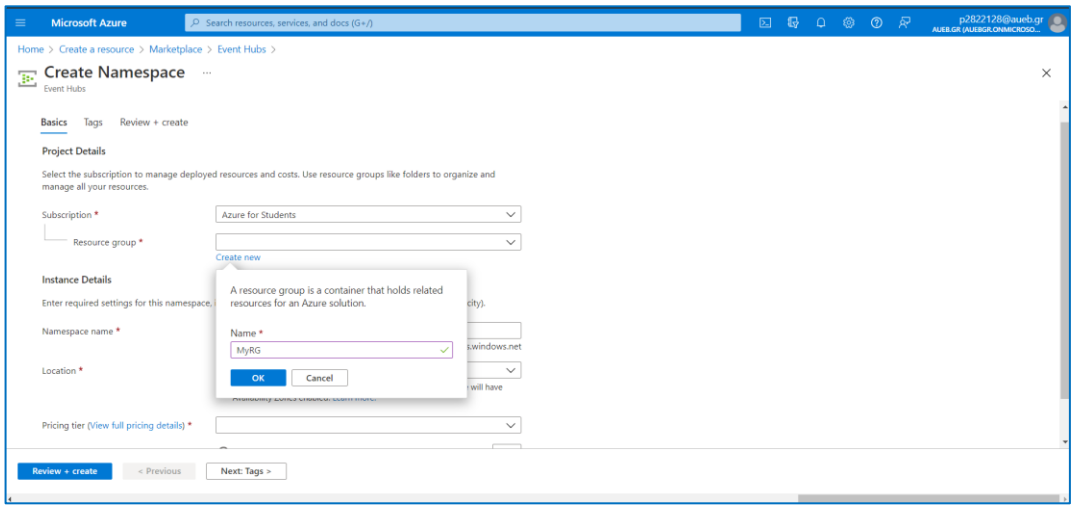

Figure 2-4 Recourse Group named “MyRG”

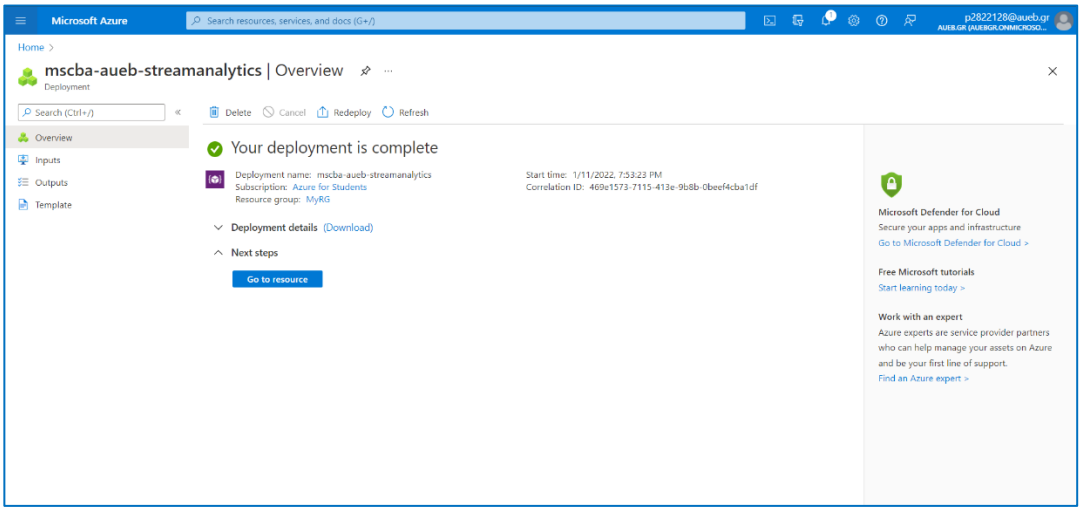

Figure 2-5 Successful Deployment Message

The we created an **Event hub**, which would receive and process our ATM events per second:

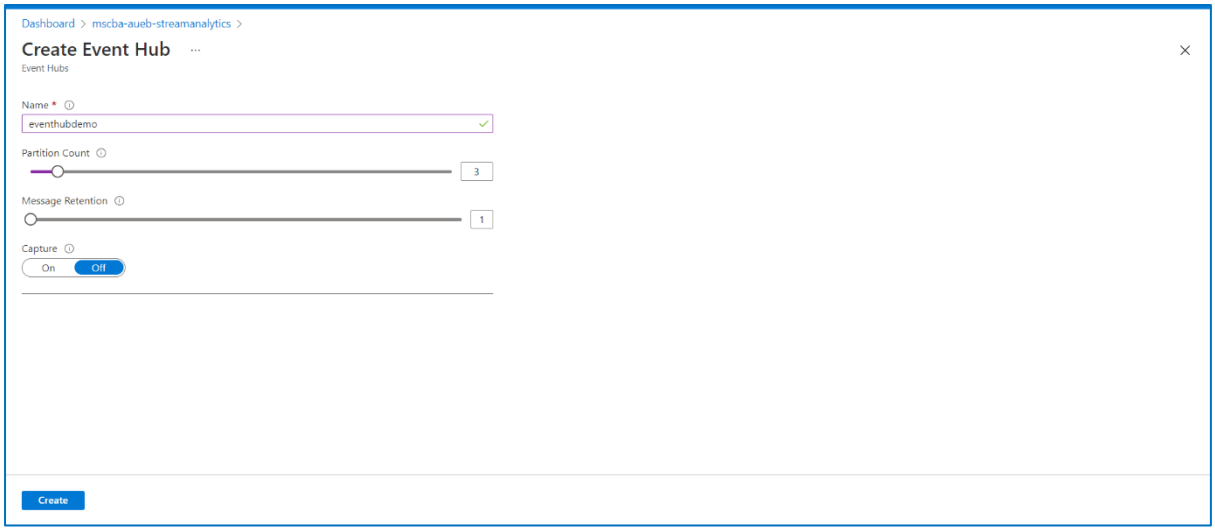

Figure 2-6 New Event Hub named "eventhubemo"

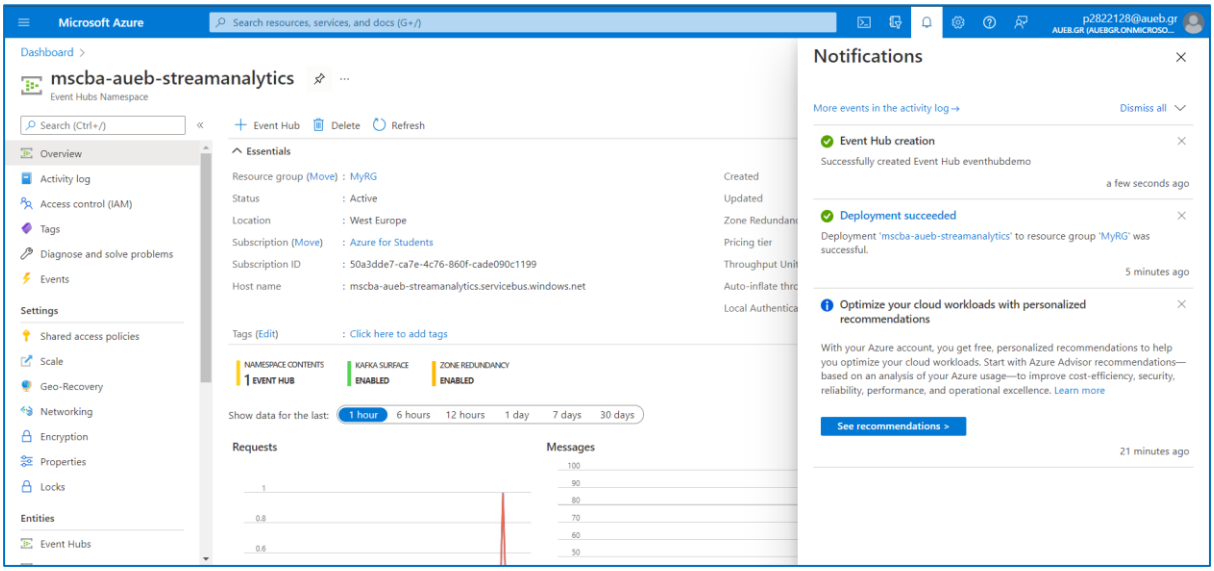

Figure 2-7 Successful Creation

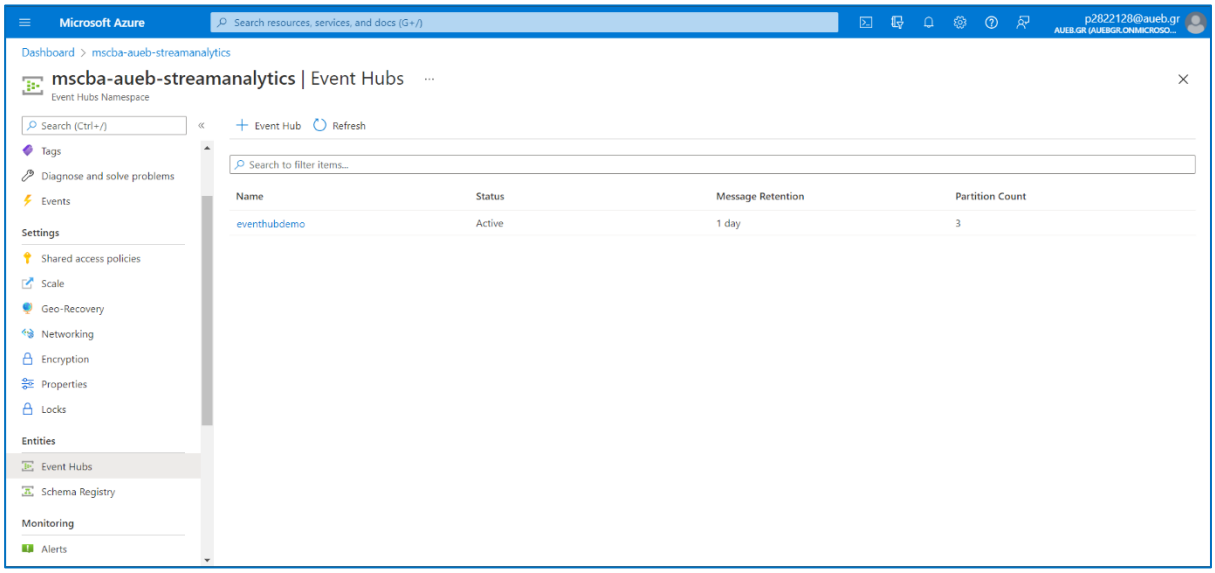

Figure 2-8 Active Status of "eventhubdemo" Event Hub

The next step is to create the **Shared Access Policies** of the Event Hub, named "MySendPolicy" and "MyRecPolicy":

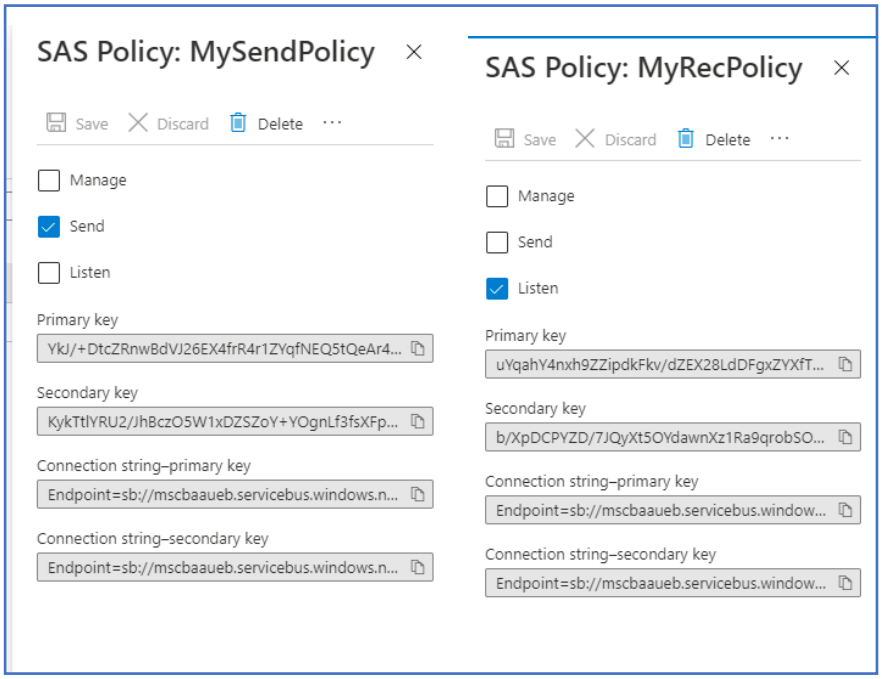

Figure 2-9 Shared Access Policies Creation

To generate a **Security Access Signature**, we download the Events Hub Signature Generator from the above link (https://github.com/sandrinodimattia/RedDog/releases) and then through "RedDog.ServiceBus.EventHubs.SignatureGenerator.exe" we create our signature:

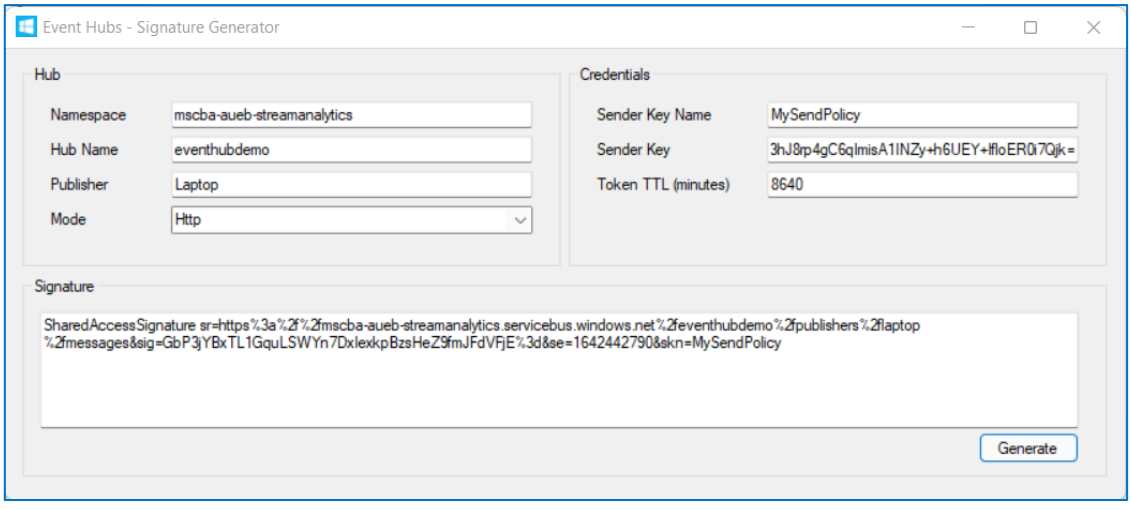

Figure 2-10 Security Access Signature Generator

Next, we edit the Generator.html file, in order to **update the CONFIG variables**:

```
/**************/
/*** CONFIG ***/
/**************/

//Use the signature generator: https://github.com/sandrinodimattia/RedDog/releases
var sas = "SharedAccessSignature sr=https%3a%2f%2fmscba-aueb-streamanalytics.servicebus.windows.net%2feventhubdemo%2fpublishers%2flaptop%2fmessages&sig=GbP3j
YBxTL1GquLSWYn7DxIexkpBzsHeZ9fmJFdVFjE%3d&se=1642442790&skn=MySendPolicy";
var serviceNamespace = "mscba-aueb-streamanalytics";
var hubName = "eventhubdemo";
var deviceName = "Laptop";
```

Figure 2-11 Editing Config Variables in Generator.html file

We are now ready to **feed our Event Hub** with the use of **Generator.html** in Chrome browser. We press “Send Data” to start the process:

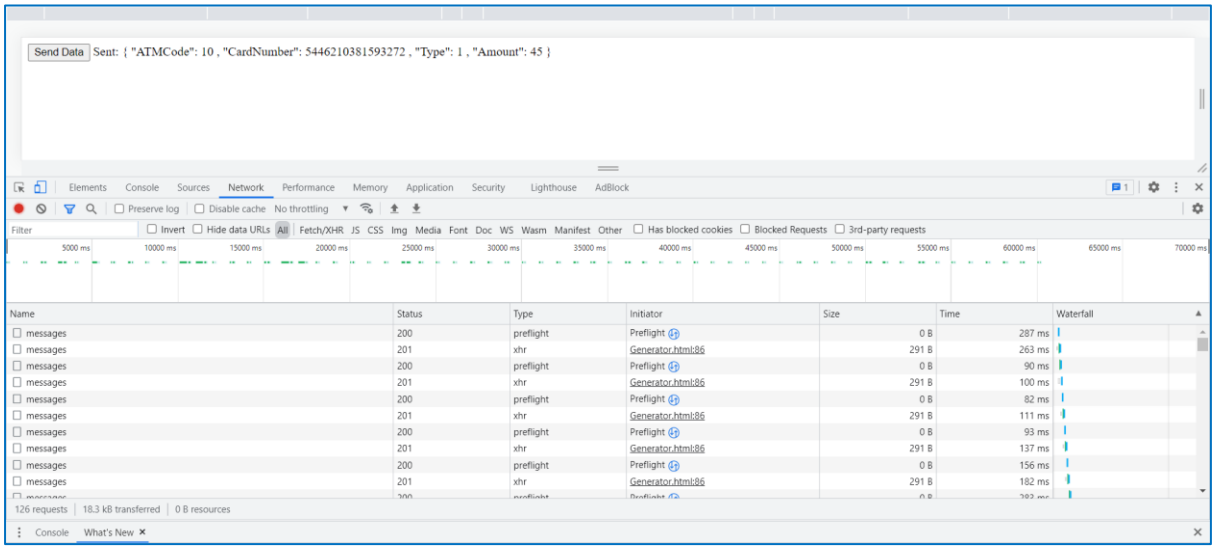

Figure 2-12 Feeding with Data the Event Hub

Afterwards, we will create an **Azure Blob Storage Account** to take advantage of cloud storage:

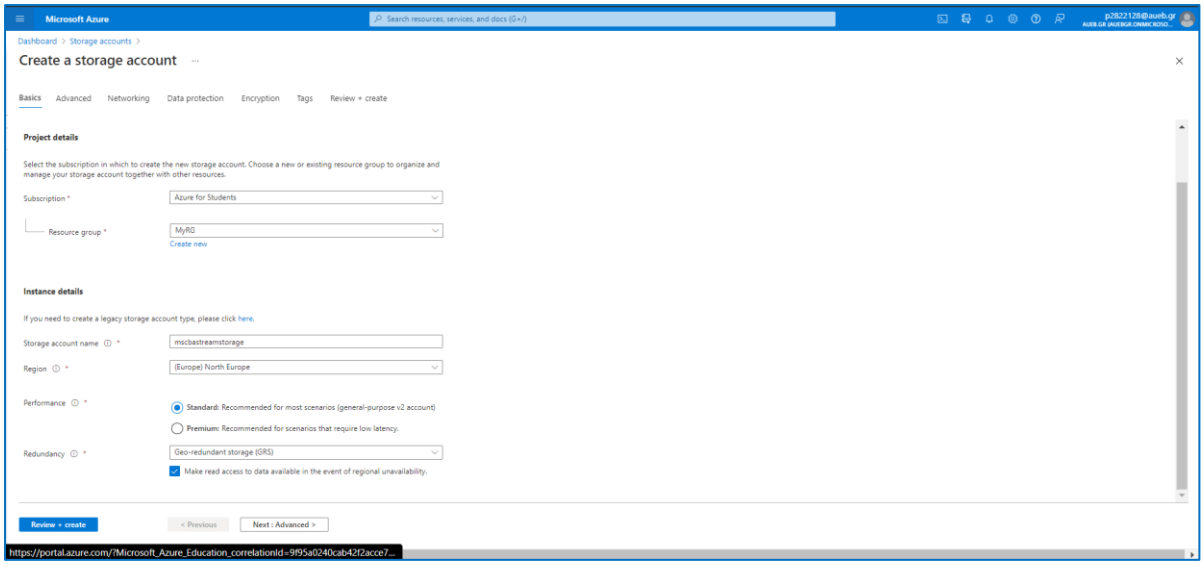

Figure 2-13 New Blob Storage Account Creation

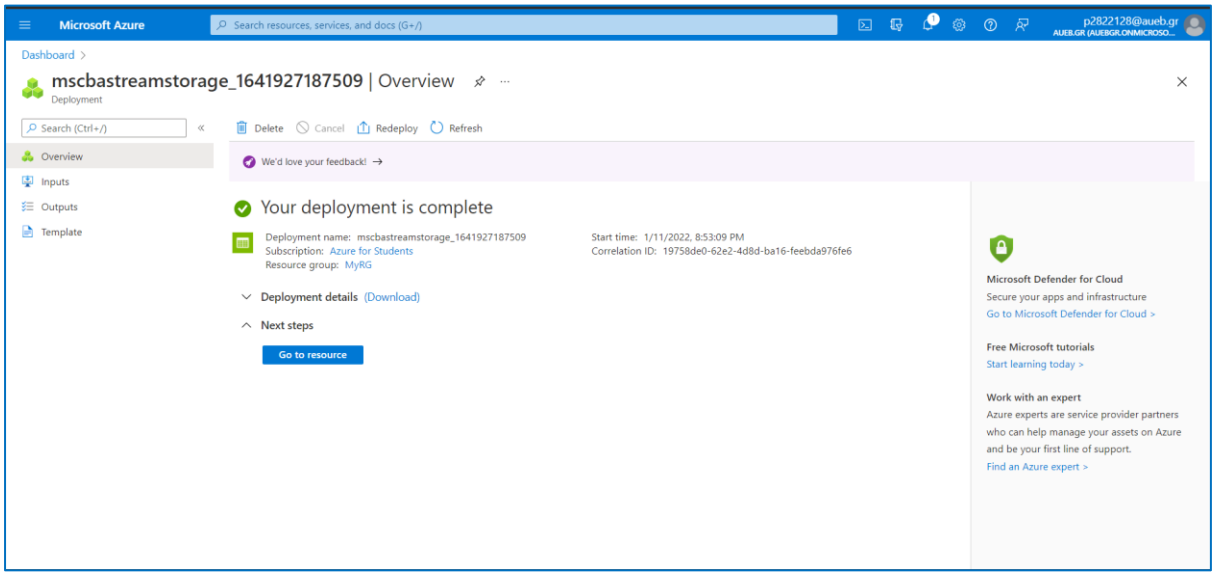

Figure 2-14 Successful Deployment Message

Inside Blob Storage environment, we create **2 new containers.** One to upload the given **reference data files** (area.json, atm.json and customer.json) and the other one to upload **the output of the stream**:

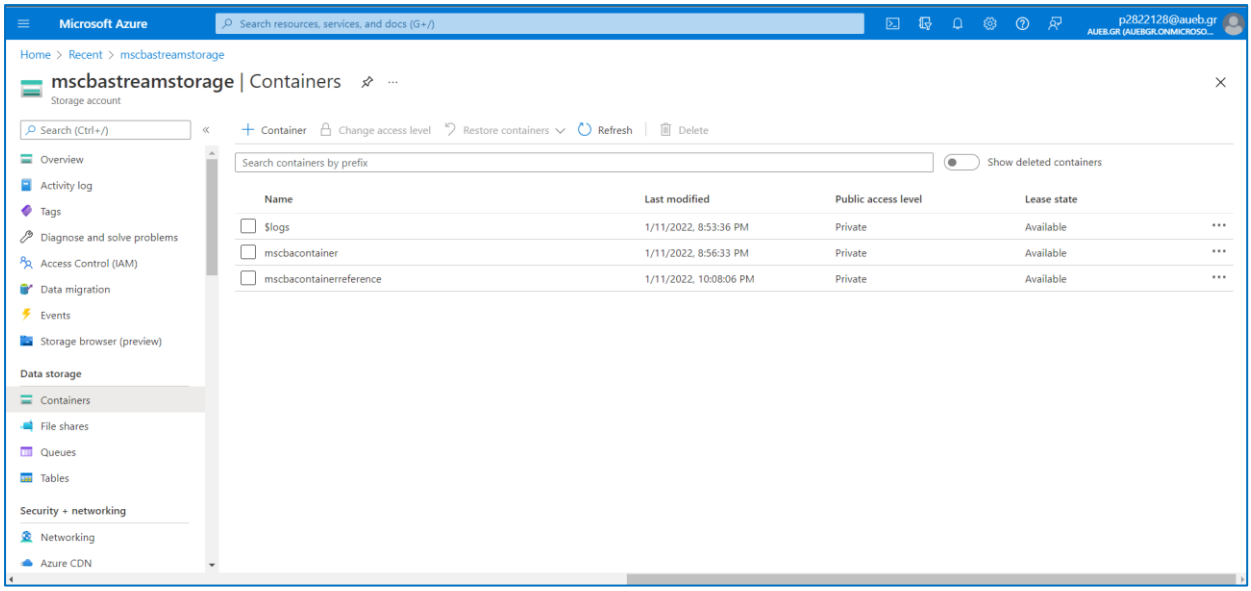

Figure 2-15 Containers Creation in Storage Account

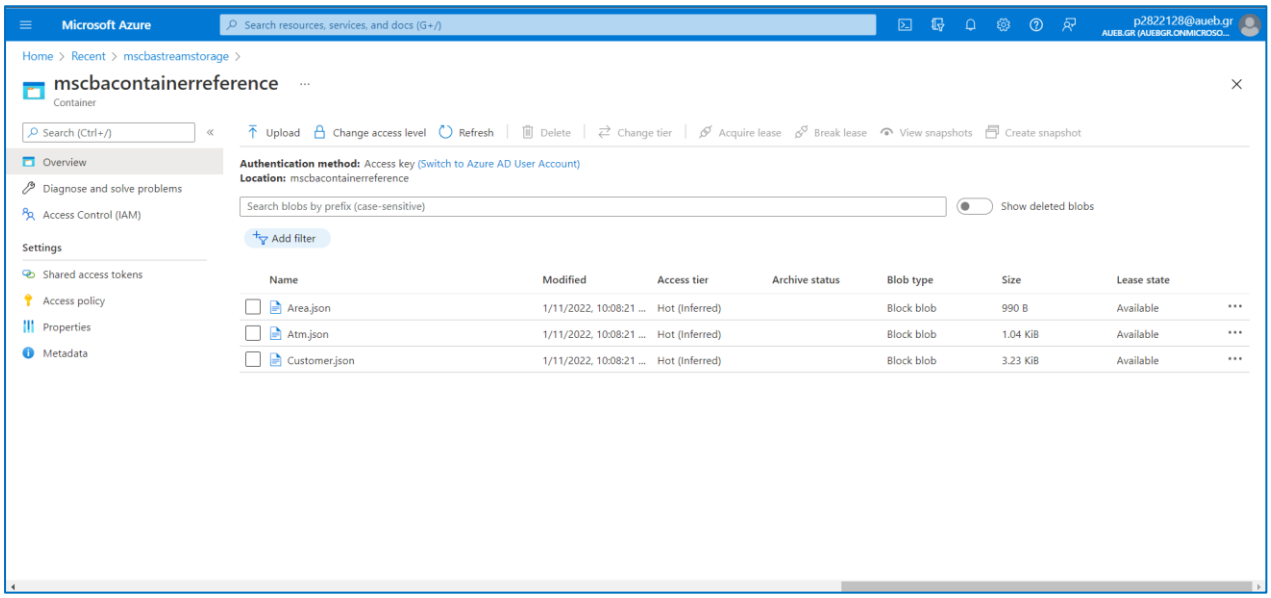

Figure 2-16 Reference Files Inside Container

We are now all set to create a **new Stream Analytics Job**. Specifically, we create a new job named “streamdemo “:

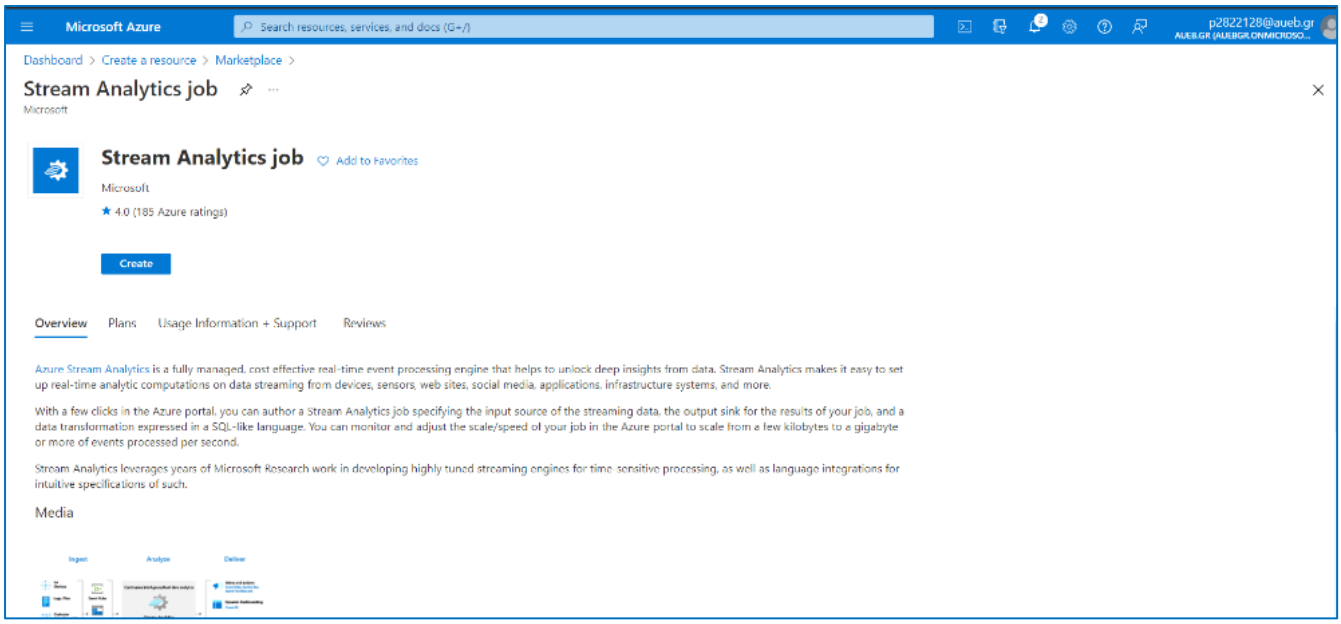

Figure 2-17 Stream Analytics job Service in Azure Marketplace

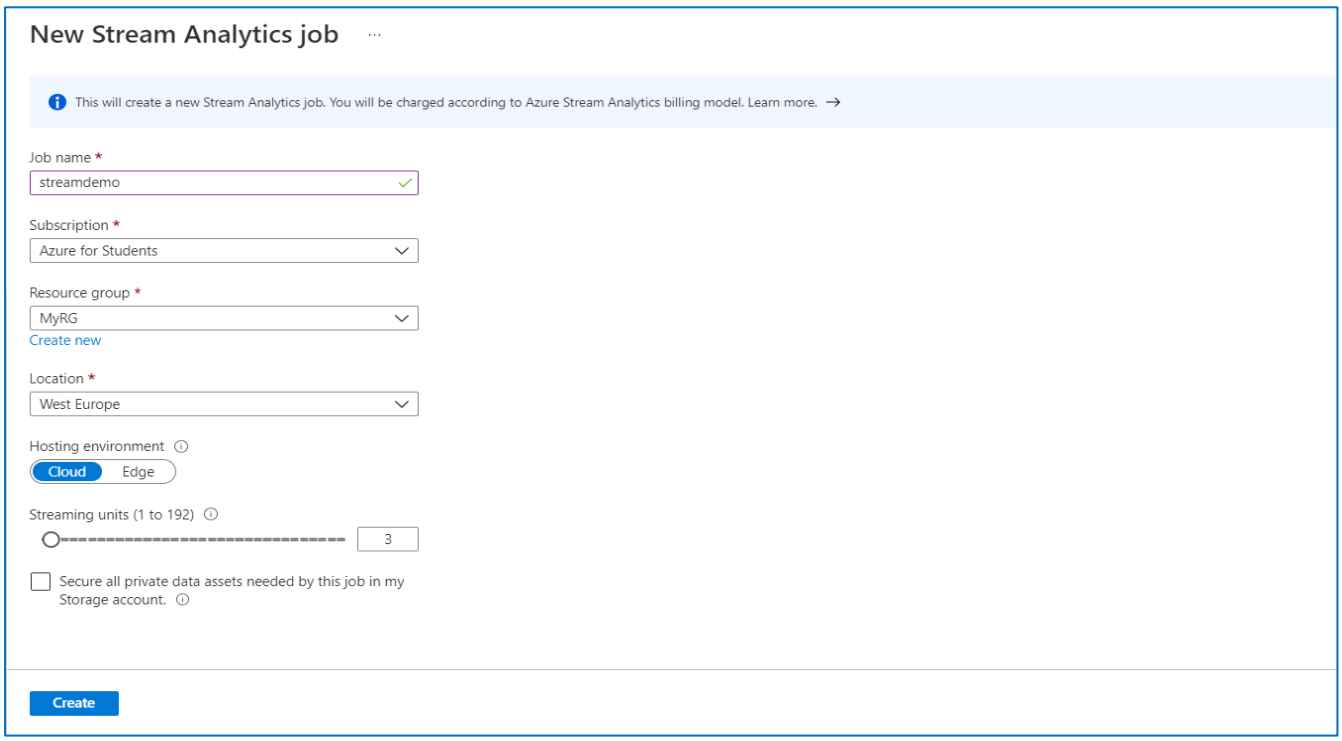

Figure 2-18 Creation of New Stream Analytics Job

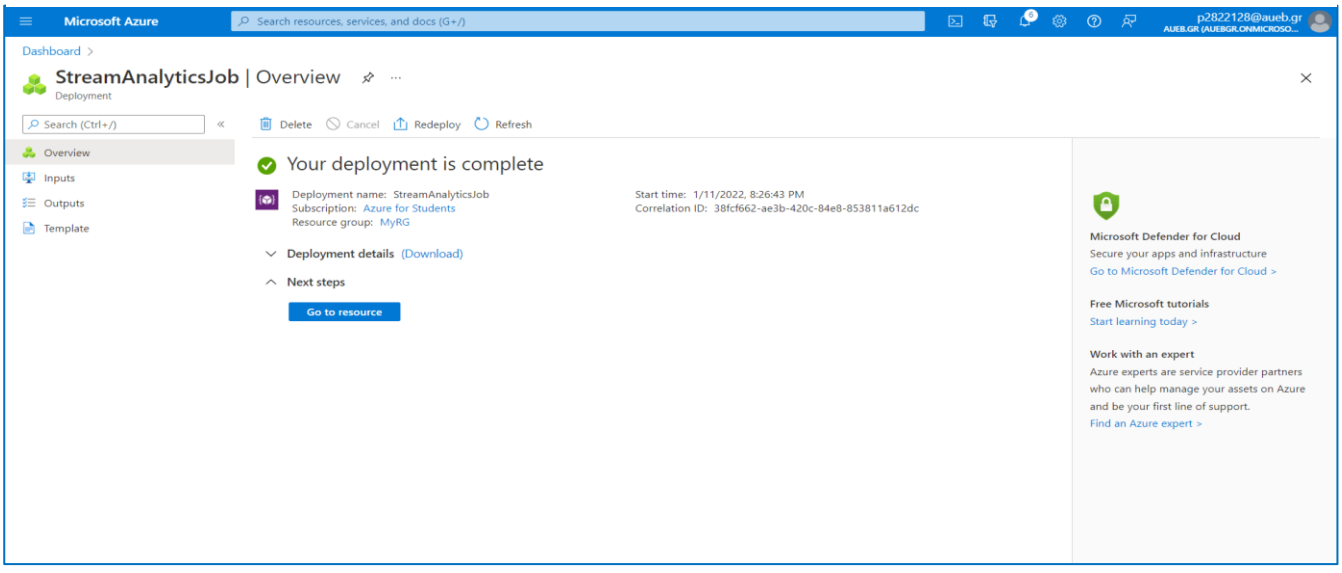

Figure 2-19 Successful Message of Deployment

Next, we **define the inputs and outputs** for our Streaming Analytics Job. At first, we add a **stream input**, using the event hub that we have created and the "MyRecPolicy" access policy:

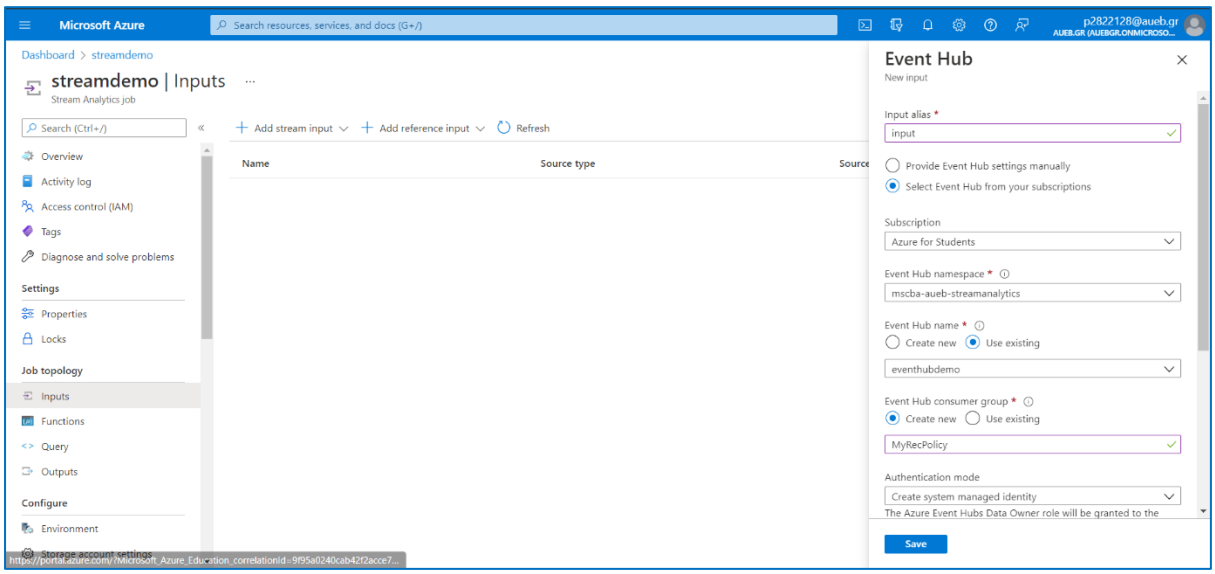

Figure 2-20 Defining Stream Input

Then we add as **reference inputs** the Area.json, Atm.json, and Customer.json files that we have uploaded in the first Blob's storage container:

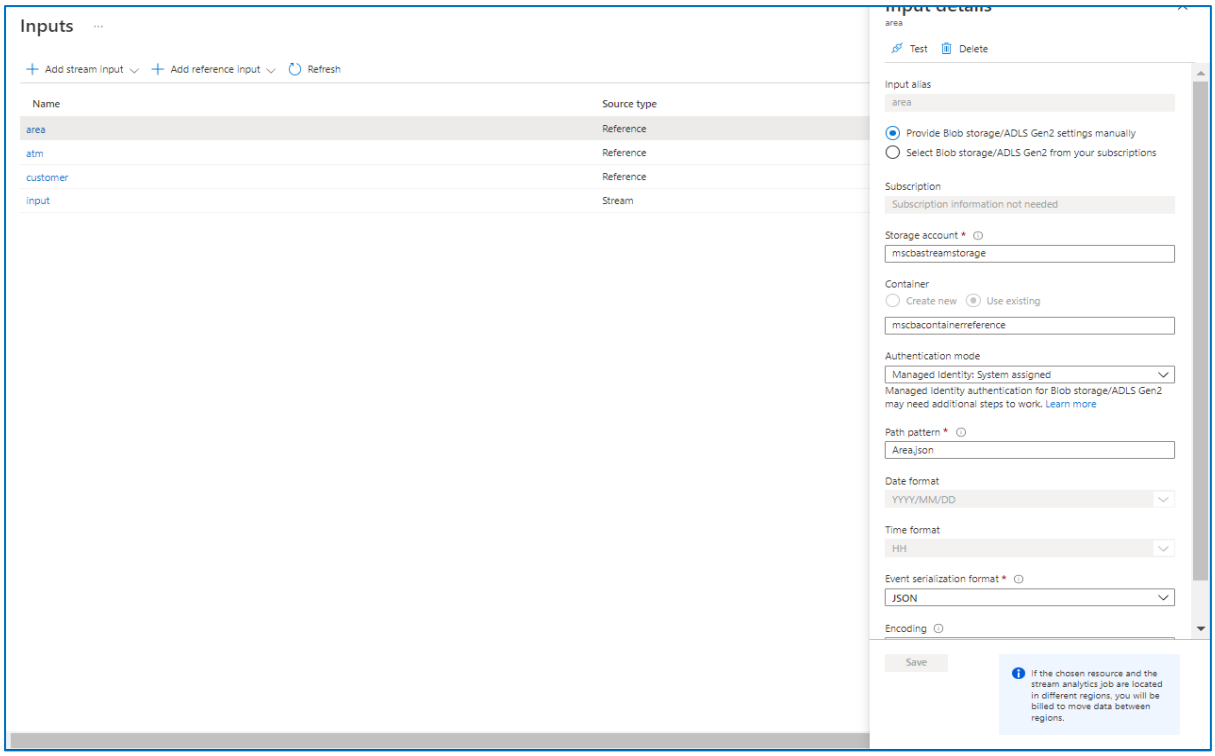

Figure 2-21 Adding Reference Inputs

Finally, we set the second container as the **stream's output:**

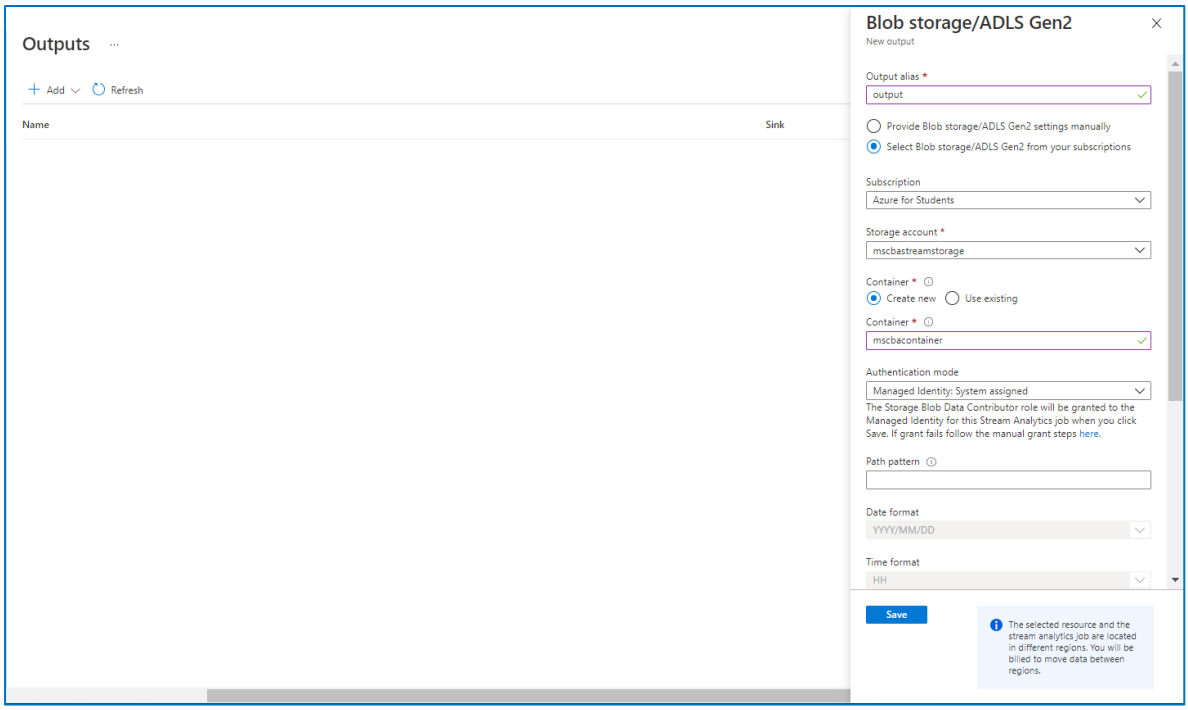

Figure 2-22 Defining Stream Input

Summing up, we have 4 inputs and 1 output:

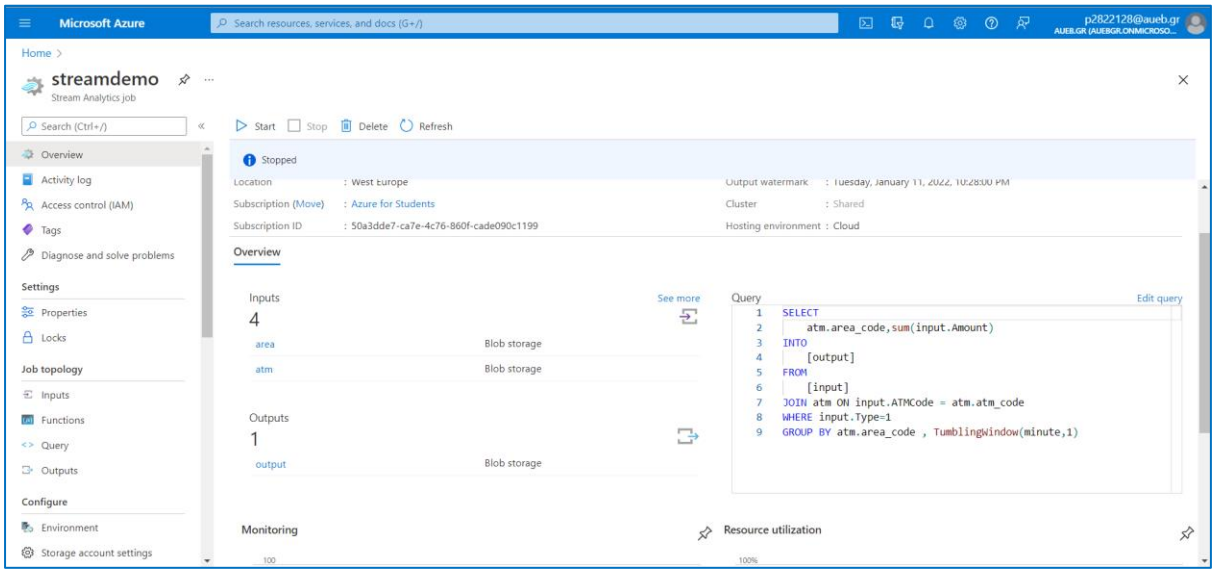

Figure 2-23 Dashboard of "streamdemo" Stream Analytics Job With Inputs and Outputs

At last, in order to run all the queries above, we will create 8 outputs, and we will store the results of each query in a different output:

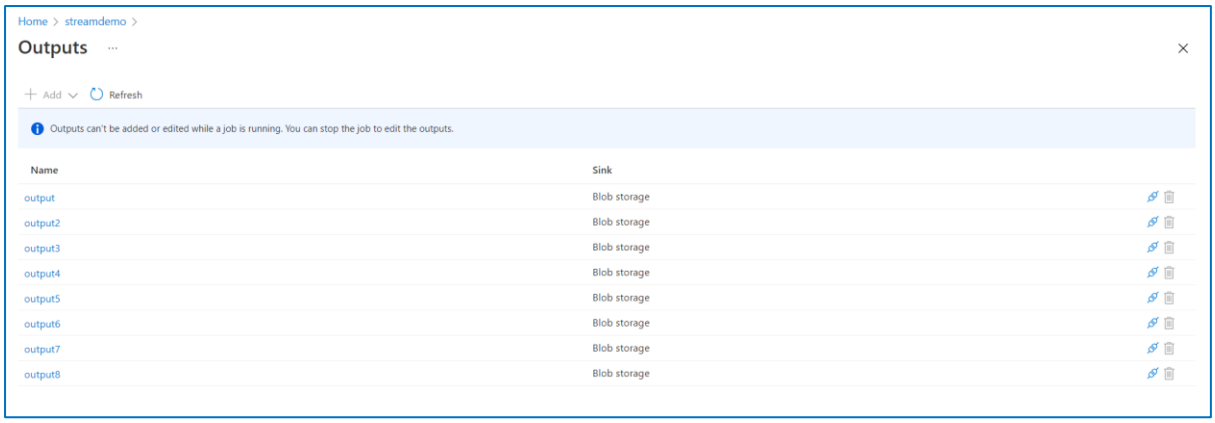

Figure 2-24 Creating Outputs in order to Store the Results

3. Queries

1. Show the total “Amount” of “Type = 0” transactions at “ATM Code = 21” of the last 10 minutes. Repeat as new events keep flowing in (use a sliding window).

➢ **Input**

```
SELECT
sum(input.Amount) AS TotalAmount,
System.Timestamp AS Time
INTO
[output]
FROM
[input]
JOIN atm ON input.ATMCode = atm.atm_code
WHERE input.Type=0 and atm.atm_code = 21
GROUP BY SlidingWindow(minute,10);
```

➢ Output


```
{"TotalAmount":10.0,"Time":"2022-01-16T09:27:39.4400000Z"}
{"TotalAmount":49.0,"Time":"2022-01-16T09:27:52.5030000Z"}
{"TotalAmount":77.0,"Time":"2022-01-16T09:28:02.4570000Z"}
{"TotalAmount":126.0,"Time":"2022-01-16T09:28:25.4670000Z"}
{"TotalAmount":139.0,"Time":"2022-01-16T09:29:04.4910000Z"}
{"TotalAmount":168.0,"Time":"2022-01-16T09:29:19.4780000Z"}
{"TotalAmount":201.0,"Time":"2022-01-16T09:30:23.9240000Z"}
{"TotalAmount":215.0,"Time":"2022-01-16T09:30:35.7560000Z"}
{"TotalAmount":260.0,"Time":"2022-01-16T09:30:38.5380000Z"}
{"TotalAmount":287.0,"Time":"2022-01-16T09:31:51.6160000Z"}
{"TotalAmount":306.0,"Time":"2022-01-16T09:32:08.1970000Z"}
{"TotalAmount":317.0,"Time":"2022-01-16T09:32:43.6900000Z"}
{"TotalAmount":348.0,"Time":"2022-01-16T09:33:37.0560000Z"}
{"TotalAmount":390.0,"Time":"2022-01-16T09:34:29.5690000Z"}
{"TotalAmount":414.0,"Time":"2022-01-16T09:37:22.6160000Z"}
{"TotalAmount":404.0,"Time":"2022-01-16T09:37:39.4400000Z"}
{"TotalAmount":365.0,"Time":"2022-01-16T09:37:52.5030000Z"}
{"TotalAmount":337.0,"Time":"2022-01-16T09:38:02.4570000Z"}
{"TotalAmount":288.0,"Time":"2022-01-16T09:38:25.4670000Z"}
{"TotalAmount":275.0,"Time":"2022-01-16T09:39:04.4910000Z"}
{"TotalAmount":246.0,"Time":"2022-01-16T09:39:19.4780000Z"}
{"TotalAmount":213.0,"Time":"2022-01-16T09:40:23.9240000Z"}
{"TotalAmount":199.0,"Time":"2022-01-16T09:40:35.7560000Z"}
{"TotalAmount":154.0,"Time":"2022-01-16T09:40:38.5380000Z"}
{"TotalAmount":127.0,"Time":"2022-01-16T09:41:51.6160000Z"}
{"TotalAmount":108.0,"Time":"2022-01-16T09:42:08.1970000Z"}
{"TotalAmount":97.0,"Time":"2022-01-16T09:42:43.6900000Z"}
{"TotalAmount":66.0,"Time":"2022-01-16T09:43:37.0560000Z"}
{"TotalAmount":24.0,"Time":"2022-01-16T09:44:29.5690000Z"}
{"TotalAmount":18.0,"Time":"2022-01-16T09:57:04.4990000Z"}
```

```
{"TotalAmount":46.0,"Time":"2022-01-16T09:58:09.6640000Z"}
{"TotalAmount":58.0,"Time":"2022-01-16T09:58:11.5690000Z"}
{"TotalAmount":77.0,"Time":"2022-01-16T09:58:48.6650000Z"}
{"TotalAmount":106.0,"Time":"2022-01-16T09:58:52.6070000Z"}
{"TotalAmount":118.0,"Time":"2022-01-16T09:59:09.6710000Z"}
{"TotalAmount":142.0,"Time":"2022-01-16T09:59:21.7410000Z"}
{"TotalAmount":188.0,"Time":"2022-01-16T10:00:10.5310000Z"}
{"TotalAmount":170.0,"Time":"2022-01-16T10:07:04.4990000Z"}
{"TotalAmount":142.0,"Time":"2022-01-16T10:08:09.6640000Z"}
{"TotalAmount":130.0,"Time":"2022-01-16T10:08:11.5690000Z"}
{"TotalAmount":111.0,"Time":"2022-01-16T10:08:48.6650000Z"}
{"TotalAmount":82.0,"Time":"2022-01-16T10:08:52.6070000Z"}
{"TotalAmount":70.0,"Time":"2022-01-16T10:09:09.6710000Z"}
{"TotalAmount":46.0,"Time":"2022-01-16T10:09:21.7410000Z"}
{"TotalAmount":10.0,"Time":"2022-01-16T10:12:22.5100000Z"}
{"TotalAmount":41.0,"Time":"2022-01-16T10:20:22.4670000Z"}
{"TotalAmount":31.0,"Time":"2022-01-16T10:22:22.5100000Z"}
{"TotalAmount":45.0,"Time":"2022-01-16T10:44:39.4950000Z"}
{"TotalAmount":92.0,"Time":"2022-01-16T10:44:52.4950000Z"}
{"TotalAmount":119.0,"Time":"2022-01-16T10:44:55.4640000Z"}
{"TotalAmount":157.0,"Time":"2022-01-16T10:44:58.4490000Z"}
{"TotalAmount":176.0,"Time":"2022-01-16T10:44:59.4800000Z"}
{"TotalAmount":211.0,"Time":"2022-01-16T10:46:23.5290000Z"}
{"TotalAmount":252.0,"Time":"2022-01-16T10:46:25.8730000Z"}
{"TotalAmount":283.0,"Time":"2022-01-16T10:47:26.5120000Z"}
{"TotalAmount":309.0,"Time":"2022-01-16T10:48:01.5140000Z"}
{"TotalAmount":343.0,"Time":"2022-01-16T10:48:08.8440000Z"}
{"TotalAmount":298.0,"Time":"2022-01-16T10:54:39.4950000Z"}
{"TotalAmount":251.0,"Time":"2022-01-16T10:54:52.4950000Z"}
{"TotalAmount":224.0,"Time":"2022-01-16T10:54:55.4640000Z"}
{"TotalAmount":186.0,"Time":"2022-01-16T10:54:58.4490000Z"}
{"TotalAmount":167.0,"Time":"2022-01-16T10:54:59.4800000Z"}
{"TotalAmount":132.0,"Time":"2022-01-16T10:56:23.5290000Z"}
{"TotalAmount":91.0,"Time":"2022-01-16T10:56:25.8730000Z"}
{"TotalAmount":60.0,"Time":"2022-01-16T10:57:26.5120000Z"}
{"TotalAmount":34.0,"Time":"2022-01-16T10:58:01.5140000Z"}
{"TotalAmount":43.0,"Time":"2022-01-16T11:04:17.5610000Z"}
{"TotalAmount":67.0,"Time":"2022-01-16T11:04:28.6730000Z"}
{"TotalAmount":93.0,"Time":"2022-01-16T11:04:47.0680000Z"}
{"TotalAmount":126.0,"Time":"2022-01-16T11:05:42.6220000Z"}
{"TotalAmount":156.0,"Time":"2022-01-16T11:05:53.6870000Z"}
{"TotalAmount":178.0,"Time":"2022-01-16T11:06:16.6880000Z"}
{"TotalAmount":223.0,"Time":"2022-01-16T11:06:26.0800000Z"}
{"TotalAmount":180.0,"Time":"2022-01-16T11:14:17.5610000Z"}
```

2. Show the total "Amount" of "Type = 1" transactions at "ATM Code = 21" of the last hour. Repeat once every hour (use a tumbling window).

➢ **Input**

```
SELECT
    sum(input.Amount) AS TotalAmount,
    System.Timestamp AS Time
INTO
    [output2]
FROM
    [input]
JOIN atm ON input.ATMCode = atm.atm_code
WHERE input.Type=1 and atm.atm_code = 21
GROUP BY TumblingWindow(hour,1);
```

➢ **Output**

```
{"TotalAmount":587.0,"Time":"2022-01-16T10:00:00.0000000Z"}
{"TotalAmount":286.0,"Time":"2022-01-16T11:00:00.0000000Z"}
```

3. Show the total "Amount" of "Type = 1" transactions at "ATM Code = 21" of the last hour. Repeat once every 30 minutes (use a hopping window).

➢ **Input**

```
SELECT
    sum(input.Amount) AS TotalAmount,
    System.Timestamp AS Time
INTO
    [output3]
FROM
    [input]
WHERE input.Type=1 and input.ATMCode = 21
GROUP BY HoppingWindow(minute,60,30);
```

➢ **Output**

```
{"TotalAmount":488.0,"Time":"2022-01-16T11:30:00.0000000Z"}
{"TotalAmount":302.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"TotalAmount":272.0,"Time":"2022-01-16T12:30:00.0000000Z"}
{"TotalAmount":267.0,"Time":"2022-01-16T13:00:00.0000000Z"}
```

4. Show the total “Amount” of “Type = 1” transactions per “ATM Code” of the last one hour (use a sliding window).

- **Input**

```
SELECT
    input.ATMCode AS AtmCode,
    sum(input.Amount) AS TotalAmount,
    System.Timestamp AS Time
INTO
    [output4]
FROM
    [input]
WHERE input.Type=1
GROUP BY input.ATMCode , SlidingWindow(hour,1);
```

- **Output**

```
{"AtmCode":21,"TotalAmount":32.0,"Time":"2022-01-
16T09:25:50.5410000Z"}
{"AtmCode":21,"TotalAmount":42.0,"Time":"2022-01-
16T09:25:51.8220000Z"}
{"AtmCode":19,"TotalAmount":23.0,"Time":"2022-01-
16T09:25:52.5410000Z"}
{"AtmCode":15,"TotalAmount":44.0,"Time":"2022-01-
16T09:25:53.6350000Z"}
{"AtmCode":10,"TotalAmount":39.0,"Time":"2022-01-
16T09:25:54.6040000Z"}
{"AtmCode":19,"TotalAmount":71.0,"Time":"2022-01-
16T09:25:55.6670000Z"}
{"AtmCode":18,"TotalAmount":50.0,"Time":"2022-01-
16T09:25:57.5100000Z"}
{"AtmCode":19,"TotalAmount":97.0,"Time":"2022-01-
16T09:25:58.5260000Z"}
{"AtmCode":10,"TotalAmount":65.0,"Time":"2022-01-
16T09:25:59.4790000Z"}
{"AtmCode":10,"TotalAmount":98.0,"Time":"2022-01-
16T09:26:00.5100000Z"}
{"AtmCode":19,"TotalAmount":119.0,"Time":"2022-01-
16T09:26:01.5110000Z"}
{"AtmCode":20,"TotalAmount":22.0,"Time":"2022-01-
16T09:26:02.5260000Z"}
{"AtmCode":15,"TotalAmount":85.0,"Time":"2022-01-
16T09:26:03.4640000Z"}
{"AtmCode":20,"TotalAmount":56.0,"Time":"2022-01-
16T09:26:07.4170000Z"}
{"AtmCode":20,"TotalAmount":91.0,"Time":"2022-01-
16T09:26:10.5270000Z"}
{"AtmCode":20,"TotalAmount":117.0,"Time":"2022-01-
16T09:26:11.4490000Z"}
{"AtmCode":19,"TotalAmount":139.0,"Time":"2022-01-
```

16T09:26:12.6830000Z"}
{"AtmCode":10,"TotalAmount":133.0,"Time":"2022-01-
16T09:26:17.4800000Z"}
{"AtmCode":15,"TotalAmount":101.0,"Time":"2022-01-
16T09:26:20.4800000Z"}
{"AtmCode":10,"TotalAmount":181.0,"Time":"2022-01-
16T09:26:23.5150000Z"}
{"AtmCode":15,"TotalAmount":149.0,"Time":"2022-01-
16T09:26:24.4690000Z"}
{"AtmCode":18,"TotalAmount":63.0,"Time":"2022-01-
16T09:26:26.4850000Z"}
{"AtmCode":13,"TotalAmount":48.0,"Time":"2022-01-
16T09:26:30.5010000Z"}
{"AtmCode":19,"TotalAmount":181.0,"Time":"2022-01-
16T09:26:31.4690000Z"}
{"AtmCode":19,"TotalAmount":202.0,"Time":"2022-01-
16T09:26:32.5160000Z"}
{"AtmCode":15,"TotalAmount":197.0,"Time":"2022-01-
16T09:26:39.5180000Z"}
{"AtmCode":20,"TotalAmount":158.0,"Time":"2022-01-
16T09:26:39.5490000Z"}
{"AtmCode":20,"TotalAmount":170.0,"Time":"2022-01-
16T09:26:39.5640000Z"}
{"AtmCode":15,"TotalAmount":247.0,"Time":"2022-01-
16T09:26:41.4710000Z"}
{"AtmCode":10,"TotalAmount":201.0,"Time":"2022-01-
16T09:26:42.4710000Z"}
{"AtmCode":17,"TotalAmount":10.0,"Time":"2022-01-
16T09:26:44.5020000Z"}
{"AtmCode":15,"TotalAmount":292.0,"Time":"2022-01-
16T09:26:45.4550000Z"}
{"AtmCode":13,"TotalAmount":84.0,"Time":"2022-01-
16T09:26:46.5650000Z"}
{"AtmCode":19,"TotalAmount":224.0,"Time":"2022-01-
16T09:26:47.7210000Z"}
{"AtmCode":15,"TotalAmount":332.0,"Time":"2022-01-
16T09:26:49.9260000Z"}
{"AtmCode":19,"TotalAmount":242.0,"Time":"2022-01-
16T09:26:56.4920000Z"}
{"AtmCode":15,"TotalAmount":361.0,"Time":"2022-01-
16T09:26:58.5390000Z"}
{"AtmCode":20,"TotalAmount":186.0,"Time":"2022-01-
16T09:26:59.4610000Z"}
{"AtmCode":18,"TotalAmount":106.0,"Time":"2022-01-
16T09:27:00.4820000Z"}
{"AtmCode":2,"TotalAmount":23.0,"Time":"2022-01-
16T09:27:03.7640000Z"}
{"AtmCode":13,"TotalAmount":101.0,"Time":"2022-01-
16T09:27:05.4990000Z"}
{"AtmCode":10,"TotalAmount":215.0,"Time":"2022-01-
16T09:27:07.4680000Z"}

```
{"AtmCode":15,"TotalAmount":372.0,"Time":"2022-01-
16T09:27:10.5300000Z"}
```


5. Show the total "Amount" of "Type = 1" transactions per "Area Code" of the last hour. Repeat once every hour (use a tumbling window).

- **Input**

```
SELECT
    atm.area_code AS AreaCode,
    sum(input.Amount)AS TotalAmount,
    System.Timestamp AS Time
INTO
    [output5]
FROM
    [input]
JOIN atm ON input.ATMCode = atm.atm_code
WHERE input.Type=1
GROUP BY atm.area_code , TumblingWindow(hour,1);
```

- **Output**


```
{"{"AreaCode":18,"TotalAmount":25.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":3,"TotalAmount":709.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":11,"TotalAmount":1879.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":5,"TotalAmount":2620.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":10,"TotalAmount":555.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":12,"TotalAmount":36.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":2,"TotalAmount":1740.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":7,"TotalAmount":694.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":15,"TotalAmount":48.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":20,"TotalAmount":42.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":14,"TotalAmount":36.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":6,"TotalAmount":53.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":1,"TotalAmount":2031.0,"Time":"2022-01-
```

```
16T10:00:00.0000000Z"}
{"AreaCode":17,"TotalAmount":23.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":9,"TotalAmount":451.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":4,"TotalAmount":1913.0,"Time":"2022-01-
16T10:00:00.0000000Z"}
{"AreaCode":3,"TotalAmount":164.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":11,"TotalAmount":1404.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":5,"TotalAmount":907.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":19,"TotalAmount":26.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":10,"TotalAmount":304.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":12,"TotalAmount":30.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":2,"TotalAmount":780.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":7,"TotalAmount":183.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":1,"TotalAmount":1249.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":9,"TotalAmount":303.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
{"AreaCode":4,"TotalAmount":1047.0,"Time":"2022-01-
16T11:00:00.0000000Z"}
```


6. Show the total “Amount” per ATM’s “City” and Customer’s “Gender” of the last hour. Repeat once every hour (use a tumbling window)

➢ **Input**

```
SELECT
    area.area_city AS City,
    customer.gender AS Gender,
    sum(input.Amount) AS TotalAmount,
    System.Timestamp AS Time
INTO
    [output6]
FROM
    [input]
JOIN atm ON input.ATMCode = atm.atm_code
JOIN customer ON input.CardNumber = customer.card_number
JOIN area ON customer.area_code = area.area_code
GROUP BY area.area_city , customer.gender ,TumblingWindow(hour,1);
```

- **Output**


```
{"City":"Vancouver","Gender":"Female","TotalAmount":444.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Dayton","Gender":"Female","TotalAmount":528.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Greeley","Gender":"Male","TotalAmount":458.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Baltimore","Gender":"Male","TotalAmount":589.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Memphis","Gender":"Male","TotalAmount":431.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Greeley","Gender":"Female","TotalAmount":1088.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Springfield","Gender":"Female","TotalAmount":621.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Omaha","Gender":"Male","TotalAmount":989.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Tacoma","Gender":"Male","TotalAmount":475.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Springfield","Gender":"Male","TotalAmount":2342.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Dayton","Gender":"Male","TotalAmount":490.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Tacoma","Gender":"Female","TotalAmount":1469.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Omaha","Gender":"Female","TotalAmount":499.0,"Time":"2022-01-16T12:00:00.0000000Z"}
{"City":"Vancouver","Gender":"Female","TotalAmount":755.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Dayton","Gender":"Female","TotalAmount":522.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Greeley","Gender":"Male","TotalAmount":281.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Baltimore","Gender":"Male","TotalAmount":526.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Memphis","Gender":"Male","TotalAmount":474.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Greeley","Gender":"Female","TotalAmount":1136.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Springfield","Gender":"Female","TotalAmount":426.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Omaha","Gender":"Male","TotalAmount":1243.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Springfield","Gender":"Male","TotalAmount":2311.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Tacoma","Gender":"Male","TotalAmount":587.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Dayton","Gender":"Male","TotalAmount":458.0,"Time":"2022-01-16T13:00:00.0000000Z"}
{"City":"Tacoma","Gender":"Female","TotalAmount":1484.0,"Time":"2022-01-16T13:00:00.0000000Z"}
```

```
{"City":"Omaha","Gender":"Female","TotalAmount":577.0,"Time":"2022-
01-16T13:00:00.0000000Z"}
```


7. Alert (Do a simple SELECT “1”) if a Customer has performed two transactions of “Type = 1” in a window of an hour (use a sliding window).

- **Input**

```
SELECT 1 AS Alert,
customer.last_name AS Surname,
System.Timestamp AS Time
INTO
    [output7]
FROM input
TIMESTAMP BY input.EventEnqueuedUtcTime
JOIN customer
ON customer.card_number = input.CardNumber
GROUP BY input.Type, customer.last_name, SlidingWindow(hour, 1)
HAVING input.Type=1 AND COUNT(*)=2
```

- **Output**


```
{"Alert":1,"Surname":"Jordan","Time":"2022-01-16T13:35:11.0090000Z"}
{"Alert":1,"Surname":"Snyder","Time":"2022-01-16T13:35:13.3370000Z"}
{"Alert":1,"Surname":"Fuller","Time":"2022-01-16T13:35:19.4930000Z"}
{"Alert":1,"Surname":"Young","Time":"2022-01-16T13:35:27.4940000Z"}
{"Alert":1,"Surname":"Stone","Time":"2022-01-16T13:35:28.6810000Z"}
{"Alert":1,"Surname":"Perry","Time":"2022-01-16T13:35:31.4800000Z"}
{"Alert":1,"Surname":"Russell","Time":"2022-01-
16T13:35:48.4870000Z"}
{"Alert":1,"Surname":"Day","Time":"2022-01-16T13:36:19.4850000Z"}
{"Alert":1,"Surname":"Perez","Time":"2022-01-16T13:36:21.5790000Z"}
{"Alert":1,"Surname":"Carroll","Time":"2022-01-
16T13:36:28.5340000Z"}
{"Alert":1,"Surname":"Moreno","Time":"2022-01-16T13:36:40.4670000Z"}
{"Alert":1,"Surname":"Bradley","Time":"2022-01-
16T13:37:05.4760000Z"}
{"Alert":1,"Surname":"Cooper","Time":"2022-01-16T13:37:32.5150000Z"}
{"Alert":1,"Surname":"Mason","Time":"2022-01-16T13:38:01.6150000Z"}
```


8. Alert (Do a simple SELECT “1”) if the “Area Code” of the ATM of the transaction is not the same as the “Area Code” of the “Card Number” (Customer’s Area Code) - (use a sliding window)

- **Input**

```
SELECT
atm.area_code AS AtmAreaCode,
customer.area_code AS CustomerAreaCode,
COUNT (*),
System.Timestamp AS Time
INTO [output8]
FROM [input]
INNER JOIN customer ON customer.card_number = input.CardNumber INNER
JOIN atm
ON atm.atm_code = input.ATMCode
WHERE atm.area_code != customer.area_code
GROUP BY atm.area_code,
customer.area_code,
SlidingWindow(hour, 1)
```

- **Output**


```
{"AtmAreaCode":10,"CustomerAreaCode":6,"COUNT":1,"Time":"2022-01-
16T09:25:50.0420000Z"}
{"AtmAreaCode":1,"CustomerAreaCode":6,"COUNT":1,"Time":"2022-01-
16T09:25:50.5410000Z"}
{"AtmAreaCode":1,"CustomerAreaCode":6,"COUNT":2,"Time":"2022-01-
16T09:25:51.8220000Z"}
{"AtmAreaCode":2,"CustomerAreaCode":1,"COUNT":1,"Time":"2022-01-
16T09:25:52.5410000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":1,"Time":"2022-01-
16T09:25:53.6350000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":1,"Time":"2022-01-
16T09:25:54.6040000Z"}
{"AtmAreaCode":2,"CustomerAreaCode":1,"COUNT":2,"Time":"2022-01-
16T09:25:55.6670000Z"}
{"AtmAreaCode":4,"CustomerAreaCode":2,"COUNT":1,"Time":"2022-01-
16T09:25:57.5100000Z"}
{"AtmAreaCode":2,"CustomerAreaCode":1,"COUNT":3,"Time":"2022-01-
16T09:25:58.5260000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":2,"Time":"2022-01-
16T09:25:59.4790000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":3,"Time":"2022-01-
16T09:26:00.5100000Z"}
{"AtmAreaCode":2,"CustomerAreaCode":1,"COUNT":4,"Time":"2022-01-
16T09:26:01.5110000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":2,"Time":"2022-01-
16T09:26:03.4640000Z"}
{"AtmAreaCode":4,"CustomerAreaCode":2,"COUNT":2,"Time":"2022-01-
16T09:26:04.4790000Z"}
{"AtmAreaCode":3,"CustomerAreaCode":4,"COUNT":1,"Time":"2022-01-
16T09:26:05.5260000Z"}
{"AtmAreaCode":9,"CustomerAreaCode":10,"COUNT":1,"Time":"2022-01-
16T09:26:09.4800000Z"}
{"AtmAreaCode":2,"CustomerAreaCode":1,"COUNT":5,"Time":"2022-01-
```

16T09:26:12.6830000Z"}
{"AtmAreaCode":10,"CustomerAreaCode":6,"COUNT":2,"Time":"2022-01-16T09:26:13.6990000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":4,"Time":"2022-01-16T09:26:14.5110000Z"}
{"AtmAreaCode":4,"CustomerAreaCode":2,"COUNT":3,"Time":"2022-01-16T09:26:15.5270000Z"}
{"AtmAreaCode":4,"CustomerAreaCode":2,"COUNT":4,"Time":"2022-01-16T09:26:16.5580000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":5,"Time":"2022-01-16T09:26:17.4800000Z"}
{"AtmAreaCode":7,"CustomerAreaCode":3,"COUNT":1,"Time":"2022-01-16T09:26:18.4960000Z"}
{"AtmAreaCode":9,"CustomerAreaCode":10,"COUNT":2,"Time":"2022-01-16T09:26:19.4640000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":3,"Time":"2022-01-16T09:26:20.4800000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":6,"Time":"2022-01-16T09:26:21.4490000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":4,"Time":"2022-01-16T09:26:22.5120000Z"}
{"AtmAreaCode":11,"CustomerAreaCode":8,"COUNT":7,"Time":"2022-01-16T09:26:23.5150000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":5,"Time":"2022-01-16T09:26:24.4690000Z"}
{"AtmAreaCode":5,"CustomerAreaCode":7,"COUNT":6,"Time":"2022-01-16T09:26:25.4850000Z"}