Project Topic Team 12

Team Members:

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Topic: Netflix Database Management System

Data Model: Relational + Document + Graph

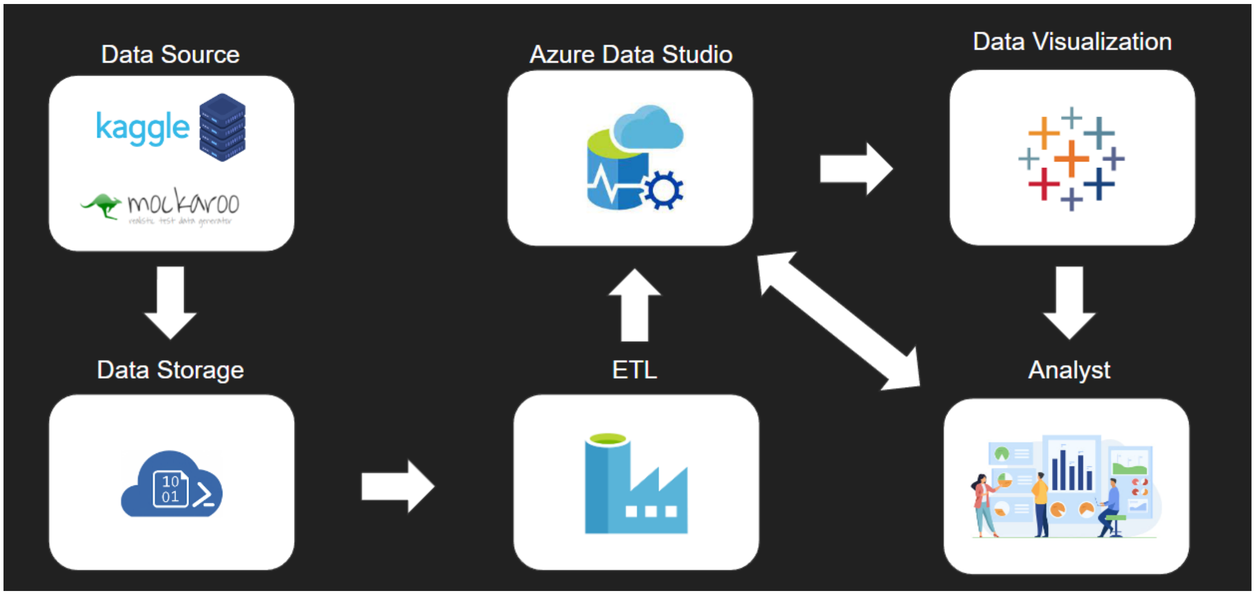
Target Platform: Azure SQL Database

Objective/Scope:

- Manage employee and group information, and implement DMLcommond(Insert, Update, Delete). Set up automated steps to synchronize group table with employee table
- Understand customer behavior, track content views, and specific customers' watching
- Filter underperforming content and track its changing trends
- Prepare monthly billing information for customers
- Evaluate and conduct trend analysis based on the plan/unit price/subscription information
- Track the top content, type, and cast of a specific time period
- Track viewing trends across different content, type, and cast
- Help Netflix make business decisions and recommendations

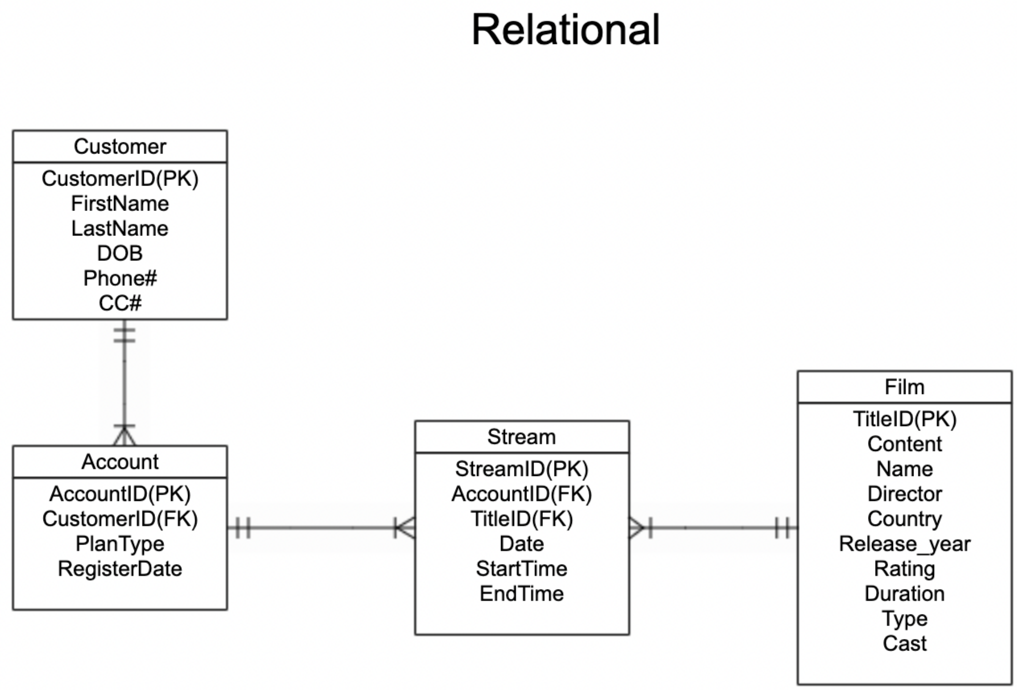
Visualizations Tool: Tableau/ Power BI

Architecture Diagram:

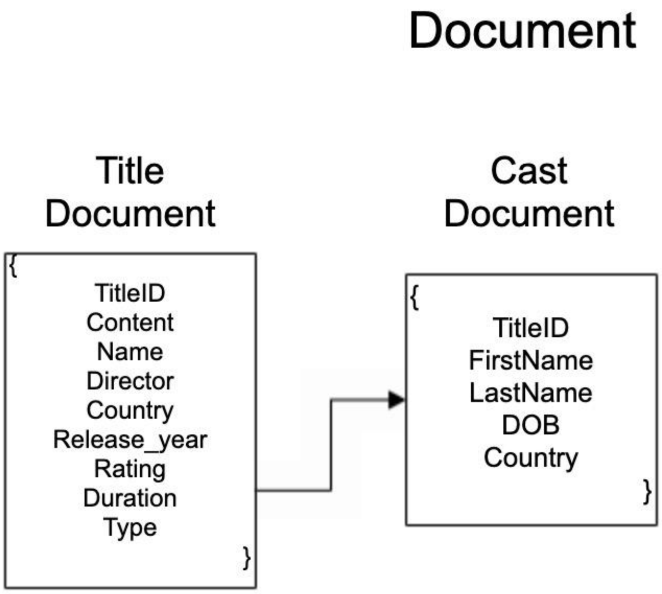


ERD:

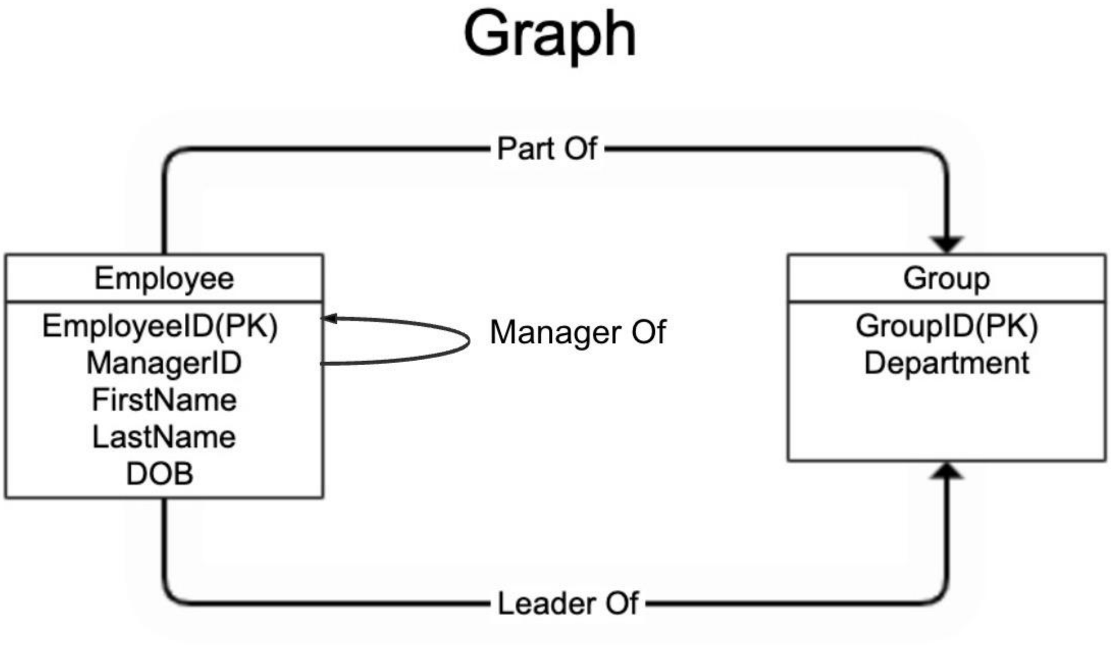
- **Relational Database**



- **Document Database**



- **Graph Database**



Business Rules:

Each customer can have more than one account but each account can correspond to only one customer

Each account can have none or many contents to watch

Each account can stream many tv shows or movies

Each tv show or movie can be streamed by many accounts

Each employee can have one or no manager

An employee who has no manager means he/she is the manager

Manager's ID is the same as the manager's employee ID

Employees who are in the same group will have the same manager

Each employee can be part of one or many groups

Each group can only have one manager

Entity and attribute:

Entity	Why Entity Included	How Entity Is Related To Other Entities
Customer	Store information of Customers. Using the Customer entity to maintain customer information	CustomerID is the PK of this entity. Has a one-to-many relationship with the Account entity. Each customer can have many accounts
Account	Store information of Account. Using the attribute "RegisterDate" to create an auto step to remind the customer to renew their plan	AccountID is the PK of this entity. CustomerID is the FK and references CustomerID in the Customer entity. Each account can only be owned by one customer. Has a many-to-many relationship with Title entity.
Title	Store information of each tv show or movie. Include TitleID, ContentID, TypeID, Cast. Using this entity to maintain title information.	TitleID is the PK of this entity. Has a one-to-many relationship with the Content entity and Type entity. Has ContentID, TypeID as FK and reference ContentID, TypeID in Content and Type entity. Using embedding method to connect with Cast entity.

Type	Store Type information. Such as name and limit. Using limit to check if customers' DOB is available to watch the specific tv show or movie.	TypeID is the PK of this entity. Has a one-to-many relationship with the Title entity.
Content	Store Content information.	ContentID is the PK of this entity. Has a one-to-many relationship with the Title entity.
Cast	Store Cast information.	Use the embedding method to be stored in the Title entity.
Stream	Store Stream information. Record StartTime and EndTime of each stream. Using those two attributes to analyze the viewing and changing trends for each tv show or movie.	The bridge entity between the many-to-many relationship of the Account entity and the Title entity. StreamID is the PK of this entity. AccountID and TitleID are FK and reference to the AccountID, TitleID in the Account, Title entity.
Employee	Store Employee information. Each employee has a unique EmployeeID. If the employee has a manager, his/her ManagerID will be the manager's EmployeeID.	One node of the graph database. An employee is part of a group. A manager is a leader of a group. A manager is a manager of an employee.
Group	Store group information. Each group has a unique GroupID and a ManagerID. Employees in the same group will have the same ManagerID.	One node of the graph database. A group is led by a manager. And grouped by employees

Implementation:

We used Azure data factory to build **three** data pipelines for importing/converting data from csv files to corresponding databases(relational database, document database, and graph database).

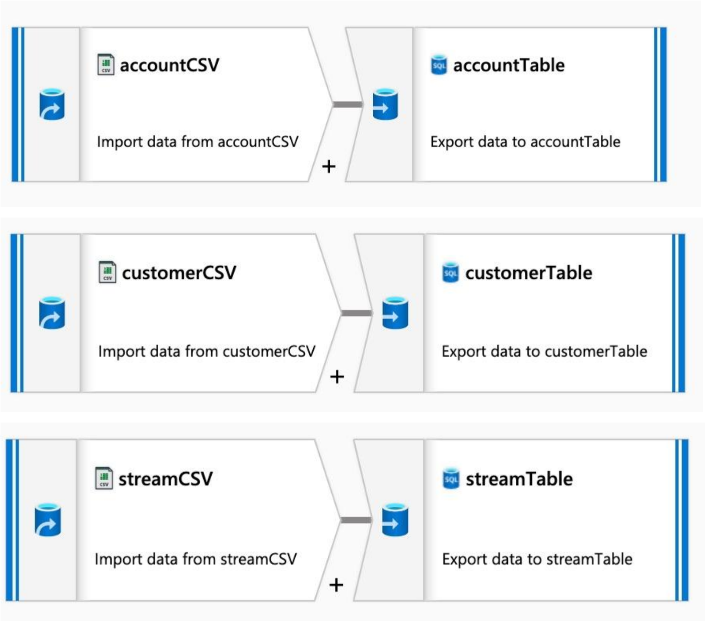
Relational Database

For importing data to the relational database, we create three data flows:

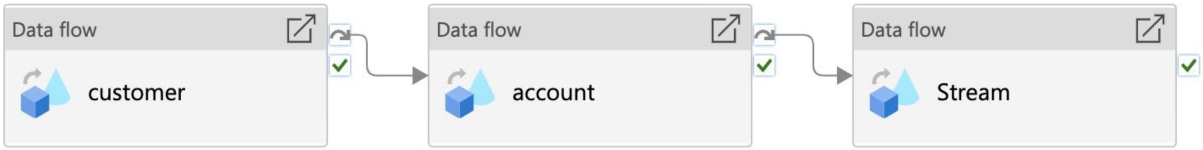
1. accountCSV to [account] table
2. CustomerCSV to [customer] table
3. streamCSV to [stream] table

And the dataflow running sequence is determined so that the data which has dependencies will be imported later than its dependencies.

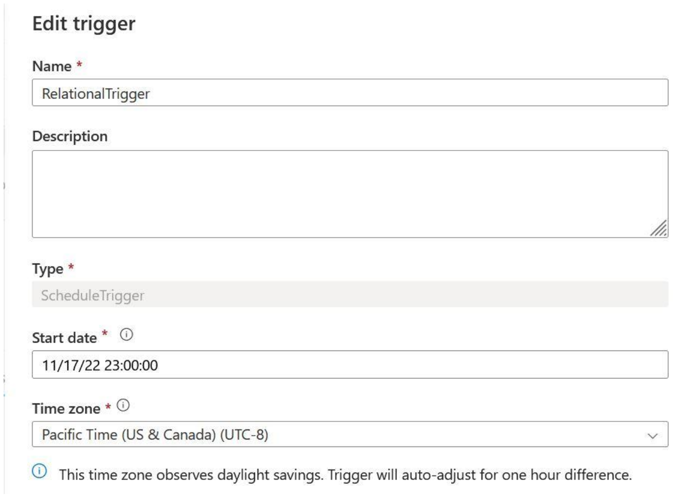
Data Flows:


accountCSV
Import data from accountCSV
accountTable
Export data to accountTable
customerCSV
Import data from customerCSV
customerTable
Export data to customerTable
streamCSV
Import data from streamCSV
streamTable
Export data to streamTable

Pipelines:



Data Refresh/Trigger:



Edit trigger

Name *
RelationalTrigger

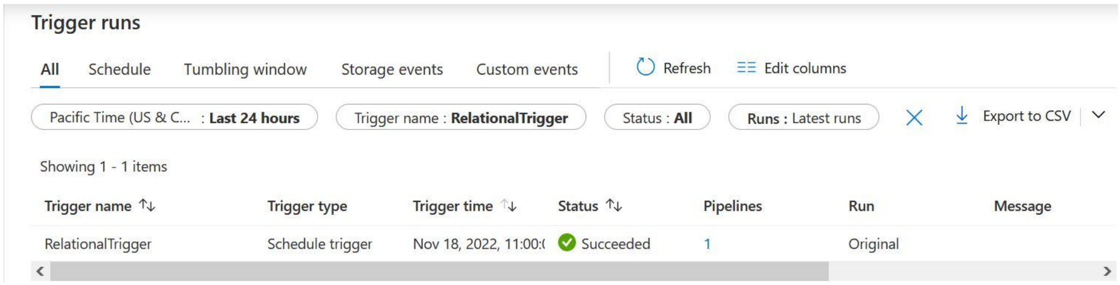
Description

Type *
ScheduleTrigger

Start date *
11/17/22 23:00:00

Time zone *
Pacific Time (US & Canada) (UTC-8)

This time zone observes daylight savings. Trigger will auto-adjust for one hour difference.



Trigger runs

Pacific Time (US & C... : **Last 24 hours** | Trigger name : **RelationalTrigger** | Status : **All** | Runs : Latest runs

Showing 1 - 1 items

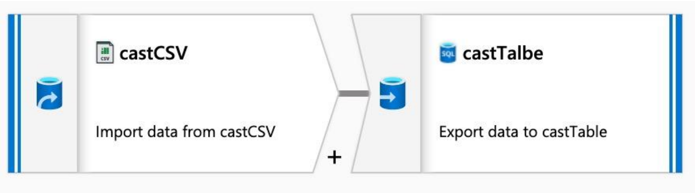
Trigger name	Trigger type	Trigger time	Status	Pipelines	Run	Message
RelationalTrigger	Schedule trigger	Nov 18, 2022, 11:00:(	✓ Succeeded	1	Original	

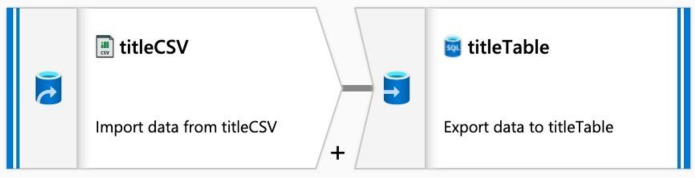
Document Database

For importing data to the document database, we create two data flows and a stored procedures:

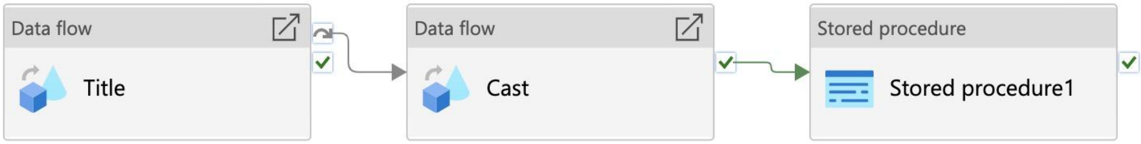
1. titleCSV to [title] table
2. castCSV to [cast] table
3. A stored procedure will be called to do the embedding work, then write to [film] table

Data Flows:



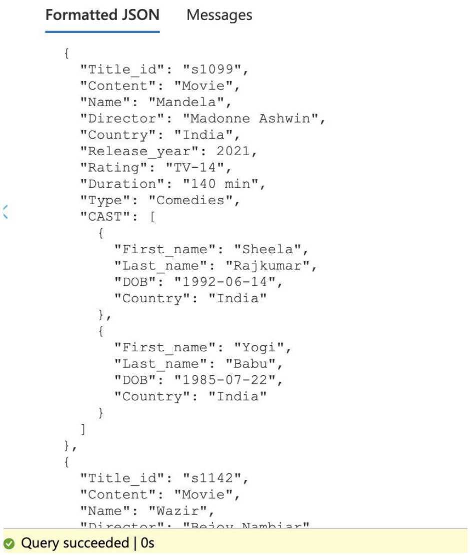


Pipelines:



Create Stored Procedure

```
CREATE PROCEDURE embedding
AS
DECLARE @json VARCHAR(MAX);
SET @json = (SELECT DISTINCT Title_id, Content, Name, Director, t2.Country,
               Release_year, Rating, Duration, Type,
               (SELECT DISTINCT First_name, Last_name, DOB, c.Country
               FROM [dbo].[Cast] c
               LEFT JOIN [dbo].[Title] t
               ON c.Title_id = t.Title_id
               WHERE t.Title_id = t2.Title_id
               FOR JSON PATH) AS CAST
FROM [dbo].[Title] t2
GROUP BY t2.Title_id, Content, Name, Director, t2.Country, Release_year, Rating,
Duration, Type
FOR JSON PATH);
INSERT INTO Film
SELECT *
FROM OPENJSON ( @json )
WITH (
             Title_id   VARCHAR(10)   '$.Title_id',
             Content     VARCHAR(20)       '$.Content',
             Name VARCHAR(50)    '$.Name',
             Director VARCHAR(50)            '$.Director',
             Country VARCHAR(50)             '$.Country',
             Release_year INT             '$.Release_year',
             Rating VARCHAR(10)              '$.Rating',
             Duration VARCHAR(50)            '$.Duration',
             Type VARCHAR(50)            '$.Type',
             [CAST]  NVARCHAR(MAX)   AS JSON
)
```

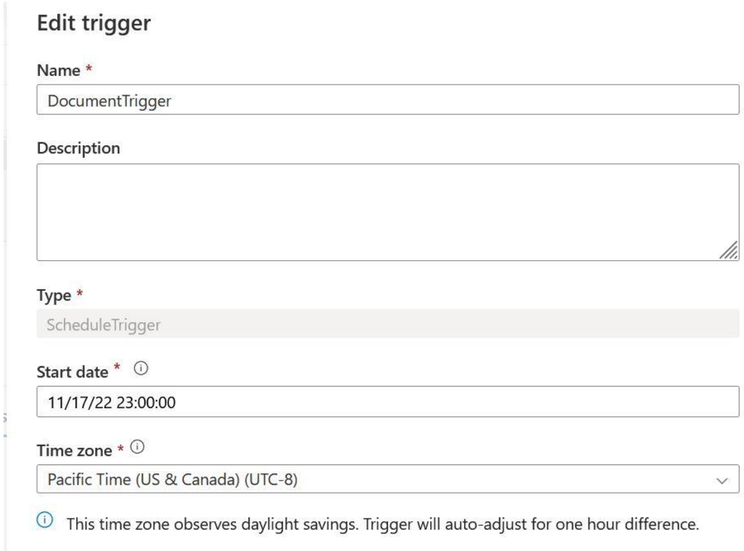


Formatted JSON Messages

```
{
  "Title_id": "s1099",
  "Content": "Movie",
  "Name": "Mandela",
  "Director": "Madonne Ashwin",
  "Country": "India",
  "Release_year": 2021,
  "Rating": "TV-14",
  "Duration": "140 min",
  "Type": "Comedies",
  "CAST": [
    {
      "First_name": "Sheela",
      "Last_name": "Rajkumar",
      "DOB": "1992-06-14",
      "Country": "India"
    },
    {
      "First_name": "Yogi",
      "Last_name": "Babu",
      "DOB": "1985-07-22",
      "Country": "India"
    }
  ]
},
{
  "Title_id": "s1142",
  "Content": "Movie",
  "Name": "Wazir",
  "Director": "Bejoy Nambiar"
```

Query succeeded | 0s

Data Refresh/Trigger:



Edit trigger

Name *
DocumentTrigger

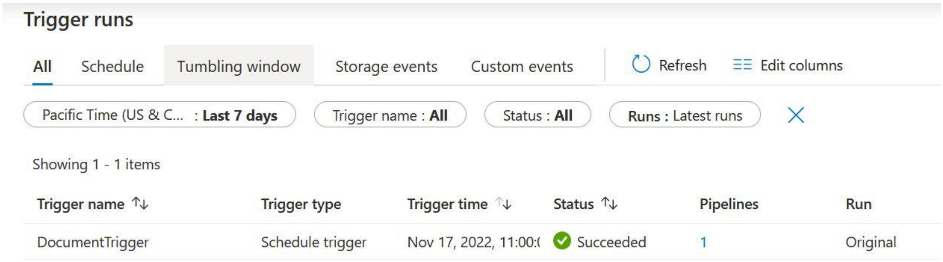
Description

Type *
ScheduleTrigger

Start date *
11/17/22 23:00:00

Time zone *
Pacific Time (US & Canada) (UTC-8)

This time zone observes daylight savings. Trigger will auto-adjust for one hour difference.



Trigger runs

Pacific Time (US & C... : Last 7 days | Trigger name : All | Status : All | Runs : Latest runs

Showing 1 - 1 items

Trigger name	Trigger type	Trigger time	Status	Pipelines	Run
DocumentTrigger	Schedule trigger	Nov 17, 2022, 11:00:(	✓ Succeeded	1	Original

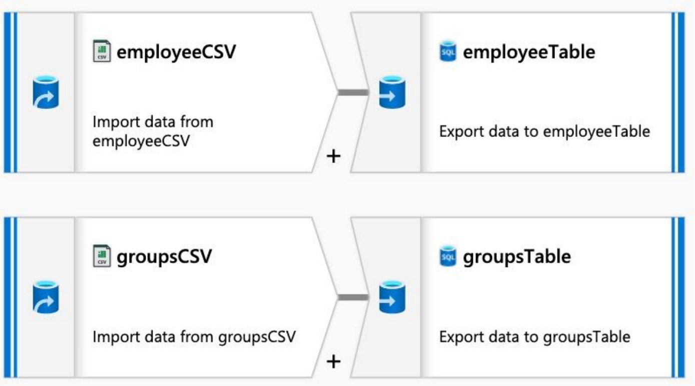
Graph Database

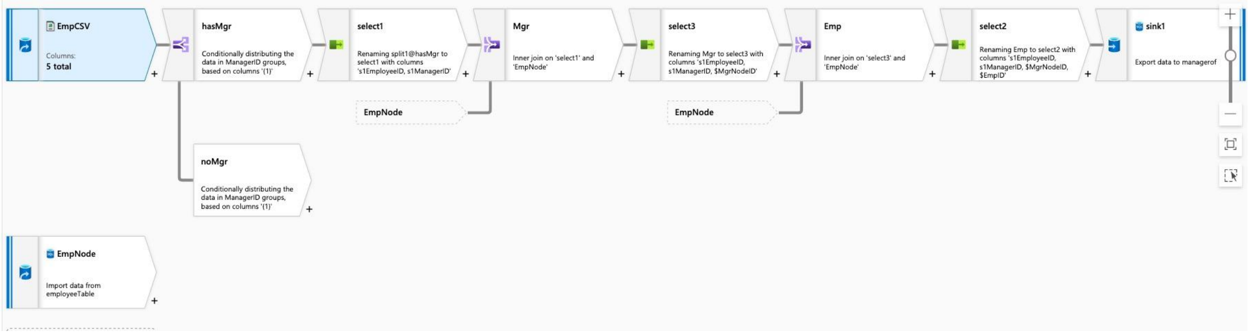
For importing data to the graph database, we create four data flows:

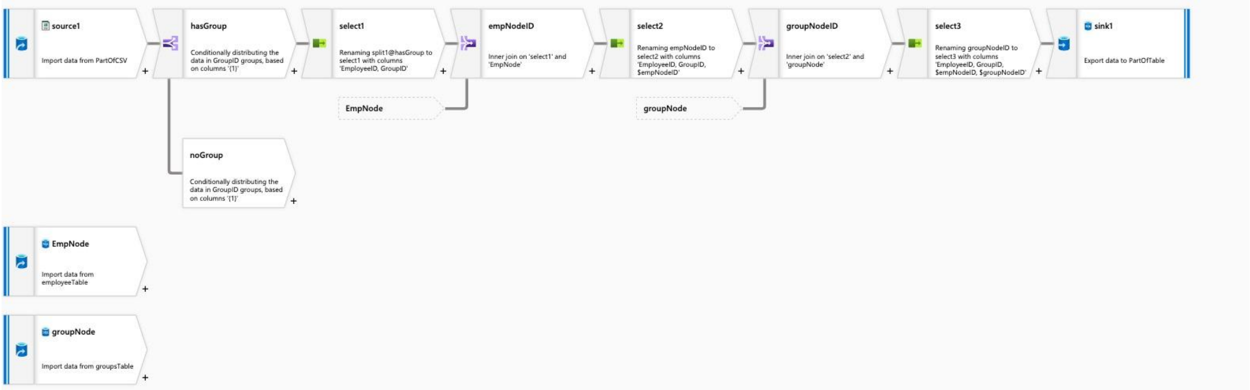
1. NodeCSV to node tables(employee table and group table)
2. edgeCSV to edge table
    a. edgeCSV to edge table[managerOf]
    b. edgeCSV to edge table[partOf]
    c. edgeCSV to edge table[leaderOf]

And the dataflow running sequence is determined so that the node tables get data before edge tables get data.

Data Flows:


employeeCSV
Import data from employeeCSV
+
employeeTable
Export data to employeeTable
groupsCSV
Import data from groupsCSV
+
groupsTable
Export data to groupsTable


EmpCSV
Columns:
5 total
+
hasMgr
Conditionally distributing the data in ManagerID groups, based on columns '(1)'
+
select1
Renaming split1@hasMgr to select1 with columns 's1EmployeeID, s1ManagerID'
+
Mgr
Inner join on 'select1' and 'EmpNode'
+
EmpNode
select3
Renaming Mgr to select3 with columns 's1EmployeeID, s1ManagerID, $MgrNodeID'
+
Emp
Inner join on 'select3' and 'EmpNode'
+
EmpNode
select2
Renaming Emp to select2 with columns 's1EmployeeID, s1ManagerID, $MgrNodeID, $EmpID'
+
sink1
Export data to managerof
noMgr
Conditionally distributing the data in ManagerID groups, based on columns '(1)'
+
EmpNode
Import data from employeeTable
+



source1

Import data from PartOfCSV

hasGroup

Conditionally distributing the data in GroupID groups, based on columns '{1}'

select1

Renaming split1@hasGroup to select1 with columns 'EmployeeID, GroupID'

empNodeID

Inner join on 'select1' and 'EmpNode'

select2

Renaming empNodeID to select2 with columns 'EmployeeID, GroupID, $empNodeID'

groupNodeID

Inner join on 'select2' and 'groupNode'

select3

Renaming groupNodeID to select3 with columns 'EmployeeID, GroupID, $empNodeID, $groupNodeID'

sink1

Export data to PartOfTable

noGroup

Conditionally distributing the data in GroupID groups, based on columns '{1}'

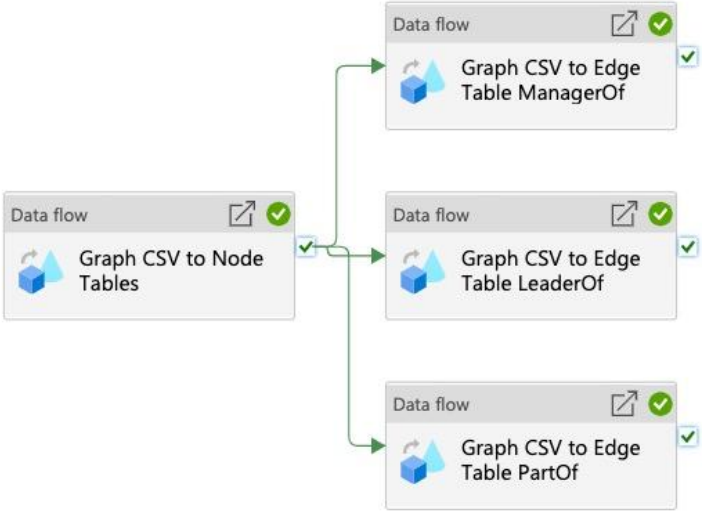
EmpNode

Import data from employeeTable

groupNode

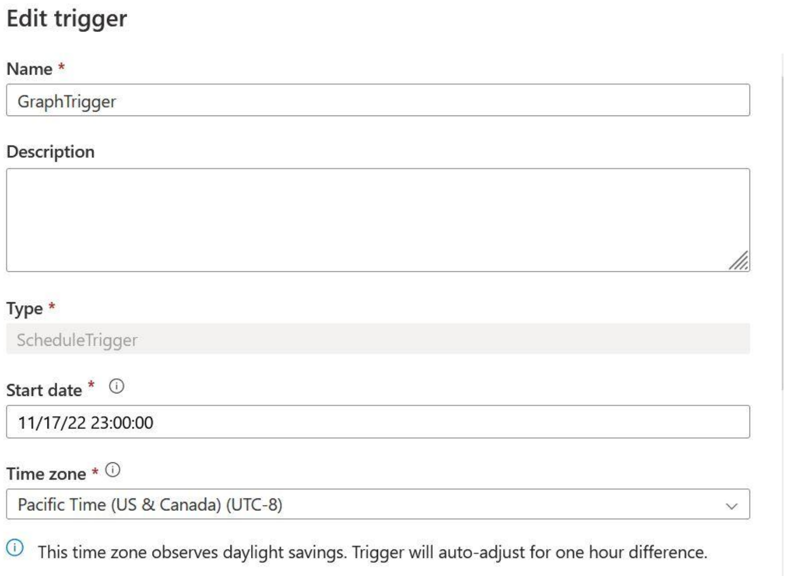
Import data from groupsTable

Pipelines:



Data flow
Graph CSV to Node Tables
Data flow
Graph CSV to Edge Table ManagerOf
Data flow
Graph CSV to Edge Table LeaderOf
Data flow
Graph CSV to Edge Table PartOf

Data Refresh/Trigger:



Edit trigger

Name *

GraphTrigger

Description

Type *

ScheduleTrigger

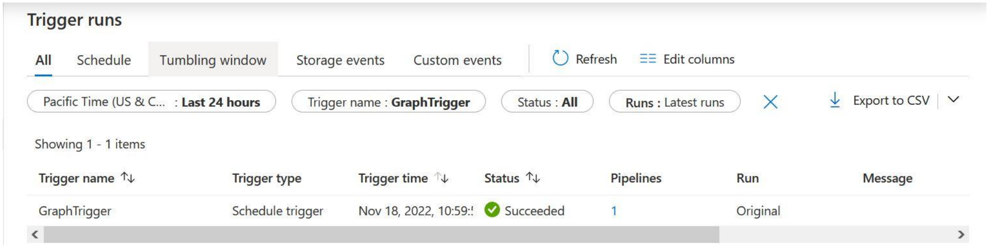
Start date * ⓘ

11/17/22 23:00:00

Time zone * ⓘ

Pacific Time (US & Canada) (UTC-8)

ⓘ This time zone observes daylight savings. Trigger will auto-adjust for one hour difference.



Trigger runs

Pacific Time (US & C... : **Last 24 hours** | Trigger name : **GraphTrigger** | Status : **All** | Runs : Latest runs

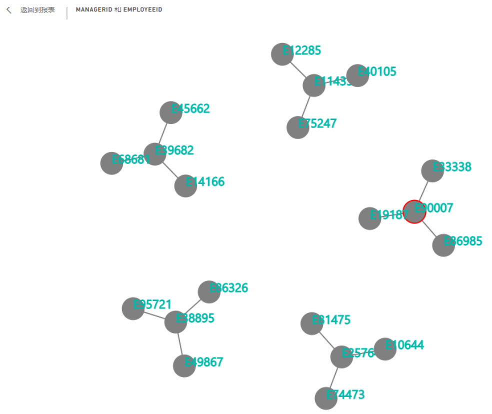
Showing 1 - 1 items

Trigger name ↑↓	Trigger type	Trigger time ↑↓	Status ↑↓	Pipelines	Run	Message
GraphTrigger	Schedule trigger	Nov 18, 2022, 10:59:!	✓ Succeeded	1	Original	

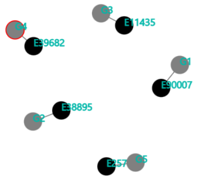
Visualization:

Employee graph:

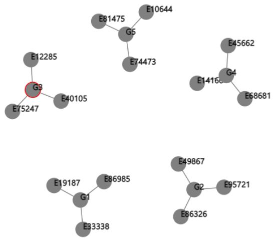
ManagerOf graph:

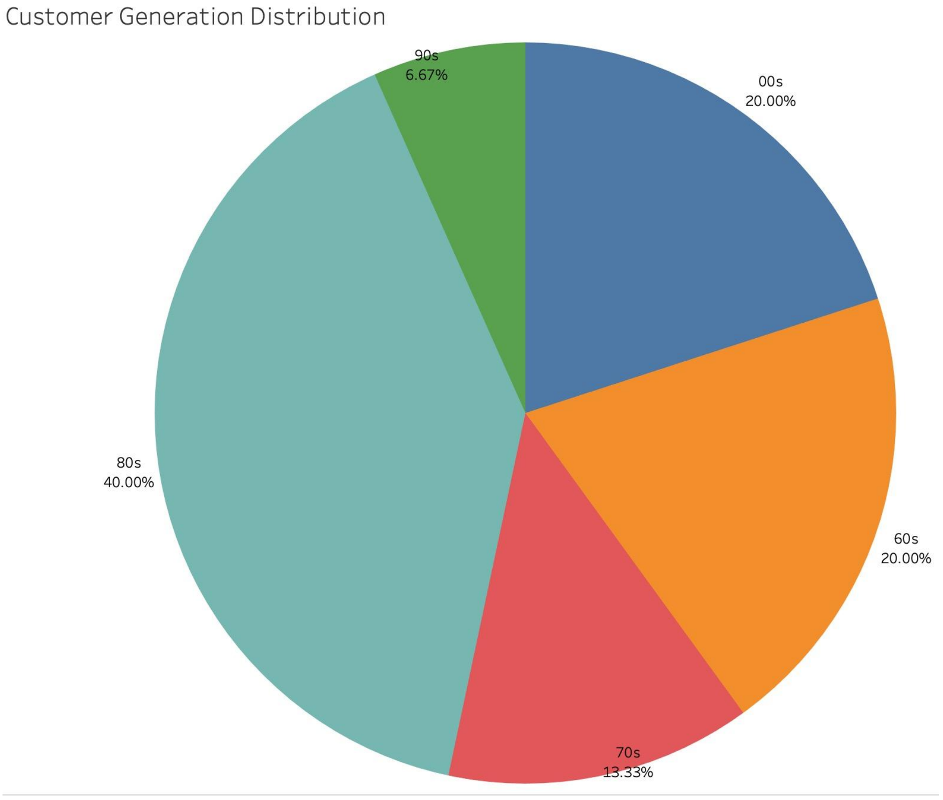


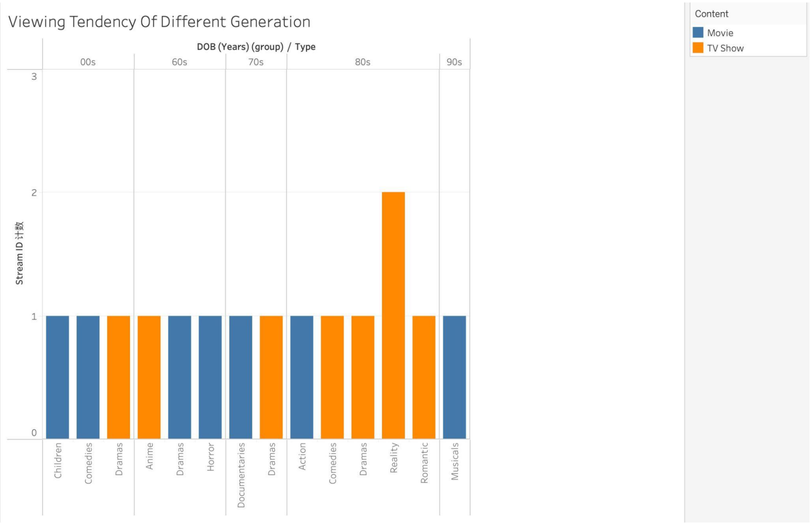
LeaderOf graph:



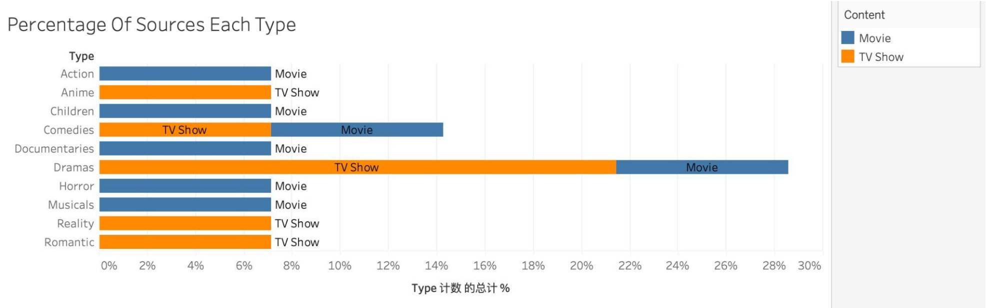
PartOf graph:



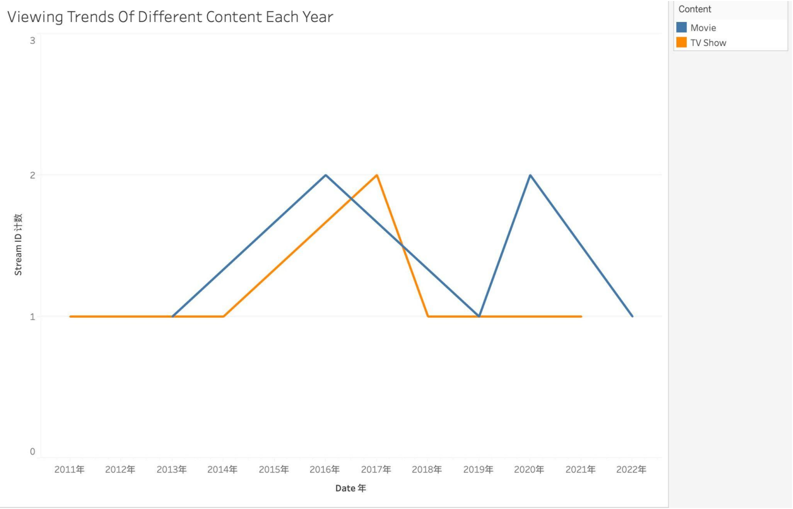




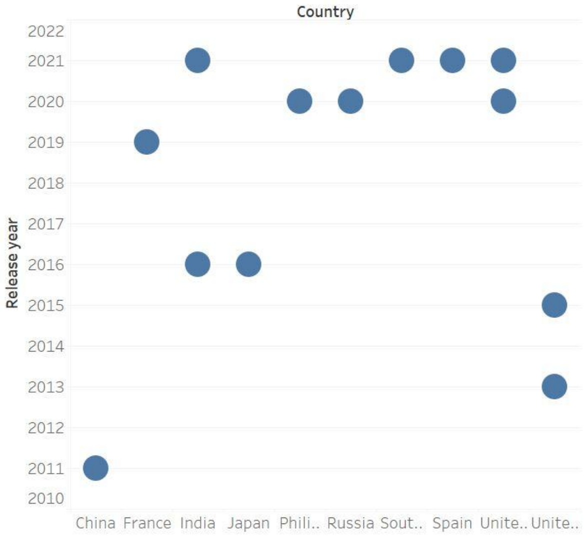
Viewing Tendency Of Different Generation



Percentage Of Sources Each Type



Viewing Trends Of Different Content Each Year



	Type (Film1.csv)									
Name	Action	Anime	Children	Comedies	Docume..	Dramas	Horror	Musicals	Reality	Romantic
Call the Midwife				■		■				
High & Low The ..	■					■				
Home			■							
Last Tango in Ha..				■		■				
Mandela		■		■			■		■	
Metallica Throug..								■		
Office Girls										■
The 8th Night		■		■			■		■	
The Great Britis..		■		■			■		■	
The House Arres..				■		■				
The Idhun Chroni..		■		■			■		■	
To the Lake				■		■				
Wazir	■					■				
Wonder Boy					■					