Project 4

Incremental Data Loading and Automated Notifications using Microsoft Fabric

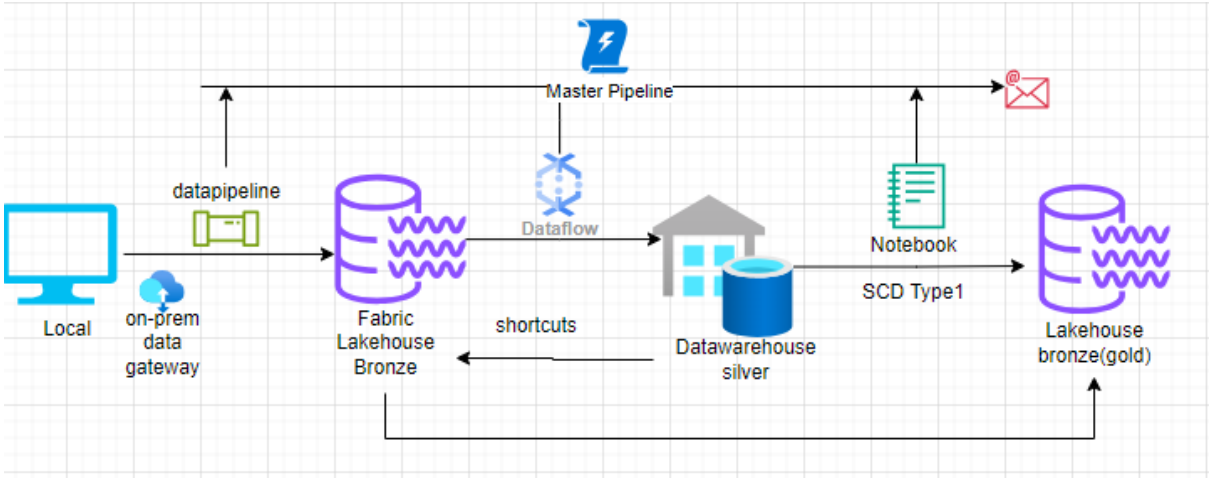
Overview:

In modern data ecosystems, organizations need to efficiently ingest, transform, and load data from various sources into centralized platforms for analytics, while also ensuring timely monitoring and notification upon successful data refreshes. This project addresses the challenge of incrementally loading data from on-premises sources to Microsoft Fabric Lakehouse, processing it through a structured transformation pipeline, and triggering automated notifications upon successful execution.

Tools & Technologies:

- Microsoft Fabric
- On-premises Data Gateway
- Fabric Lakehouse & Warehouse
- Fabric Data Flows
- Fabric Notebook

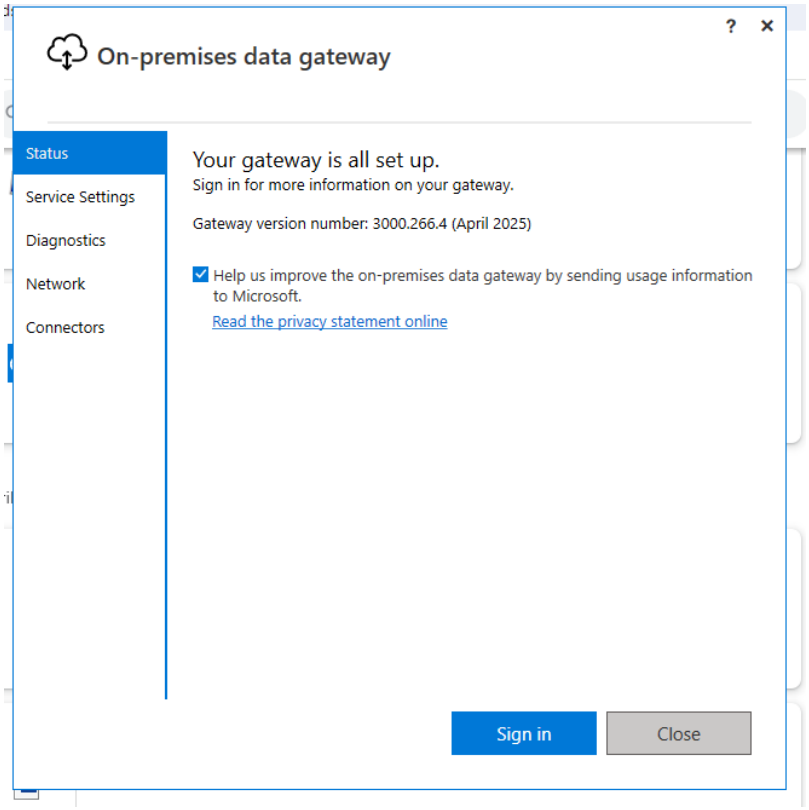
Architecture:



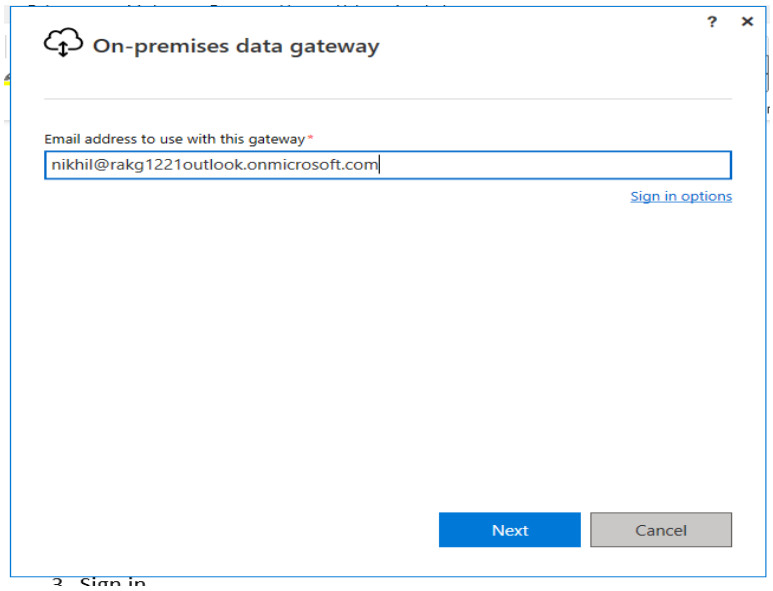
Installing On-Premises Data Gateway on Local:

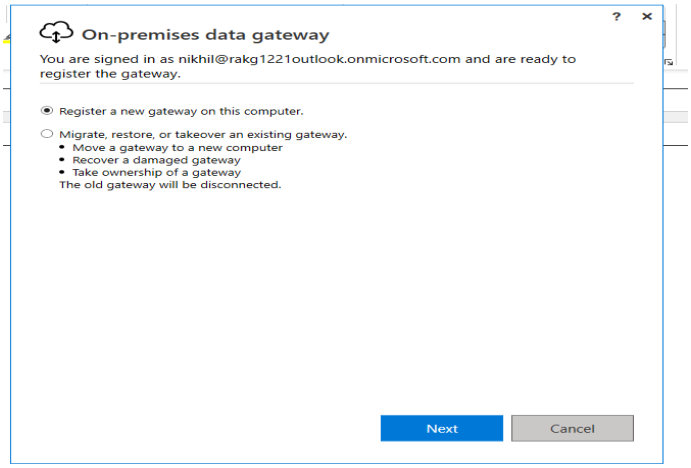
To connect on-premises data sources to fabric for data ingestion, install on-premises data gateway in source system.

1. Search on-premises Data Gateway in browser.

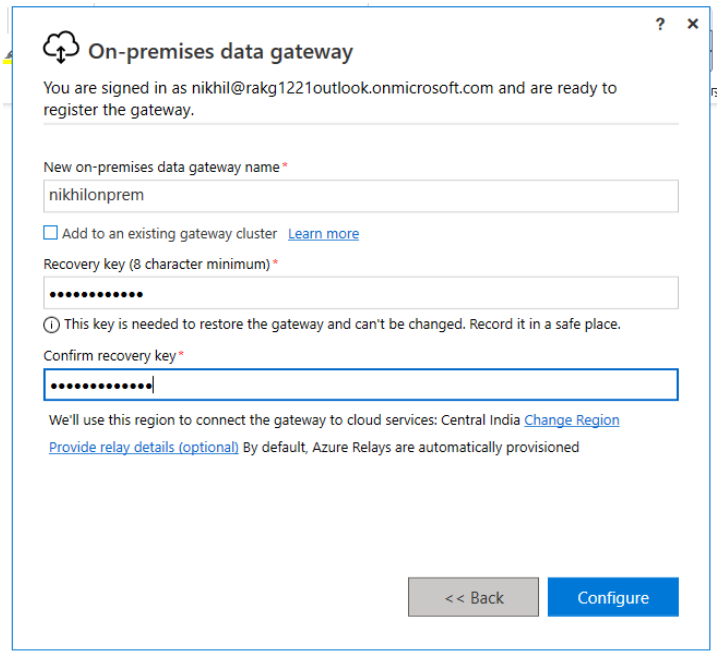


2. Accept the terms and Install
3. Sign in: sign in with the fabric registered account.

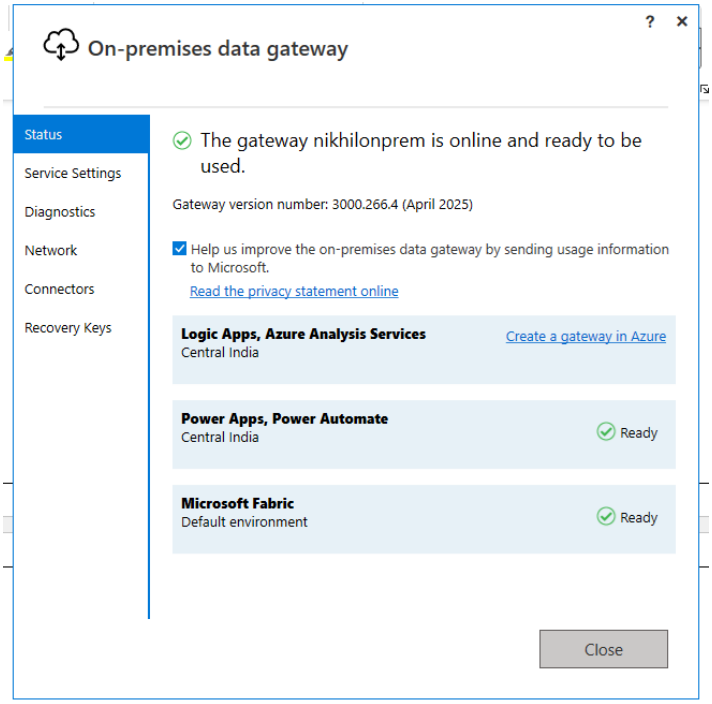




4. From the select register a new gateway on this computer.



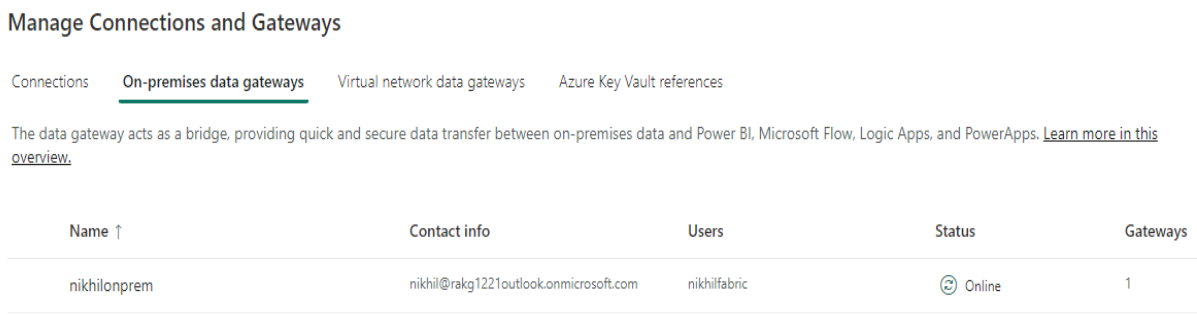
5. Provide the gateway name and password.



6. On-premises data gateway is ready.

To Ensure, if the gateway is connected to fabric

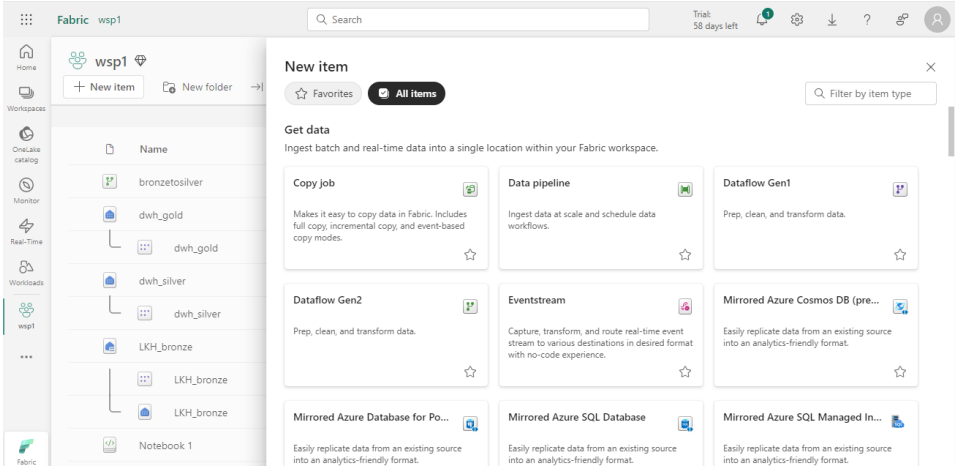
Open Microsoft Fabric→settings→Manage connections & Gateways→on-premises data gateway



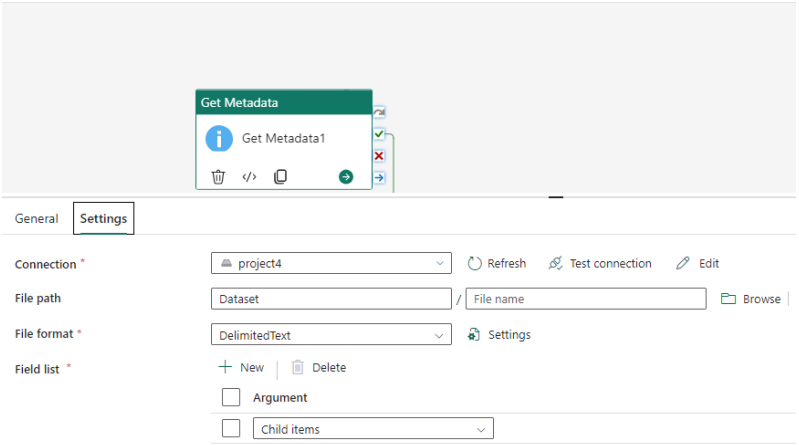
On-premises Data ingestion to Fabric Lakehouse using on-prem data gateway:

Since the data source has on-premises data gateway installed and connected to fabric, we can directly ingest the data to fabric lakehouse by providing the file path.

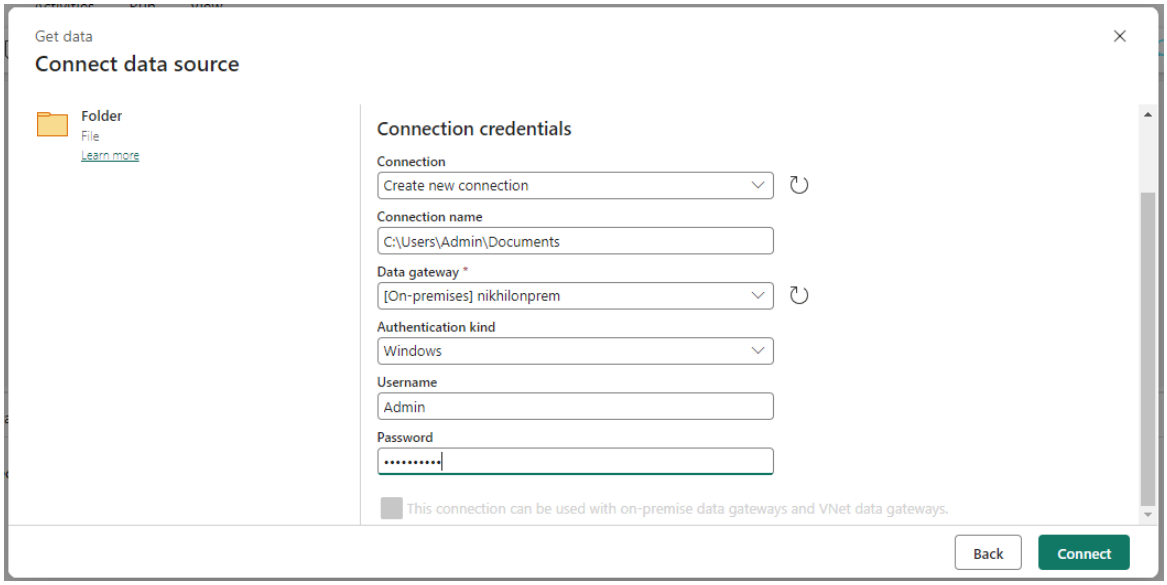
1. Create a workspace.(workspaces→+New Workspace→name,description and domain→apply).
2. Create a Lakehouse inside the workspace.(+New Item→search lakehouse→name the lakehouse).
3. Create a Data pipeline to ingest the on-prem data.
4. +New item→search Data pipeline



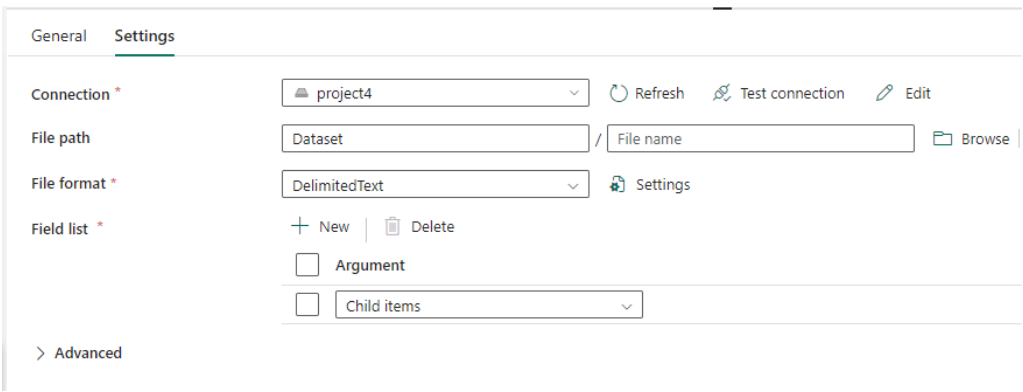
5. Name the pipeline (on-premtobronze).
6. Add Get Metadata activity to the canvas.



7. Connection→more→new source as **folder**



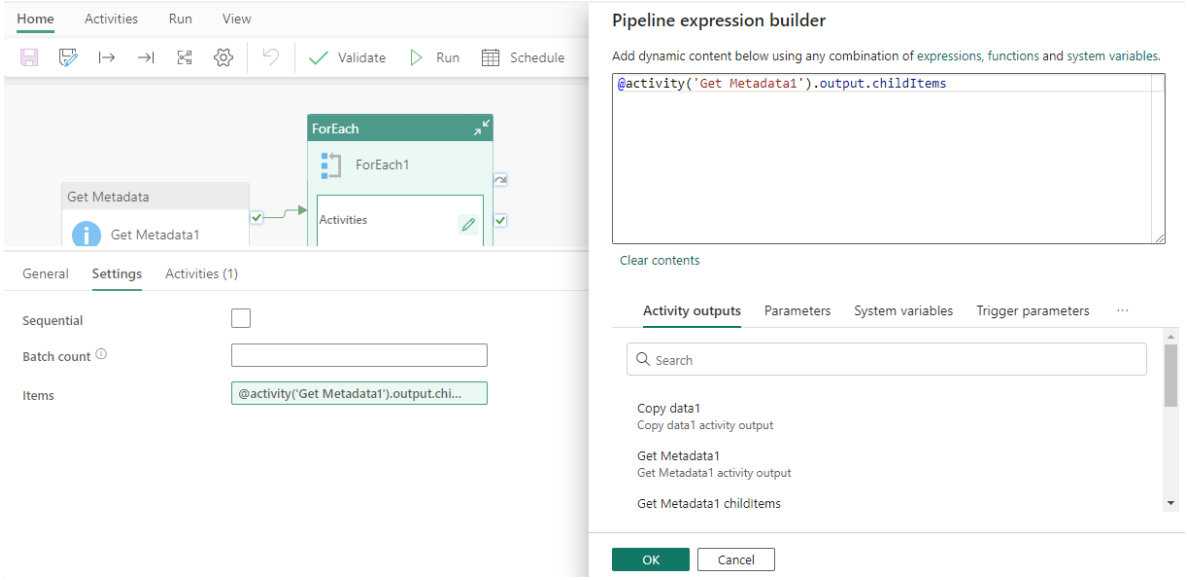
8. Provide the file path,provide connection name and select Data gateway from the drop-down and atlast provide the windows credentials.
9. Connect.



10. Browse the folder, Select Field list as child items.

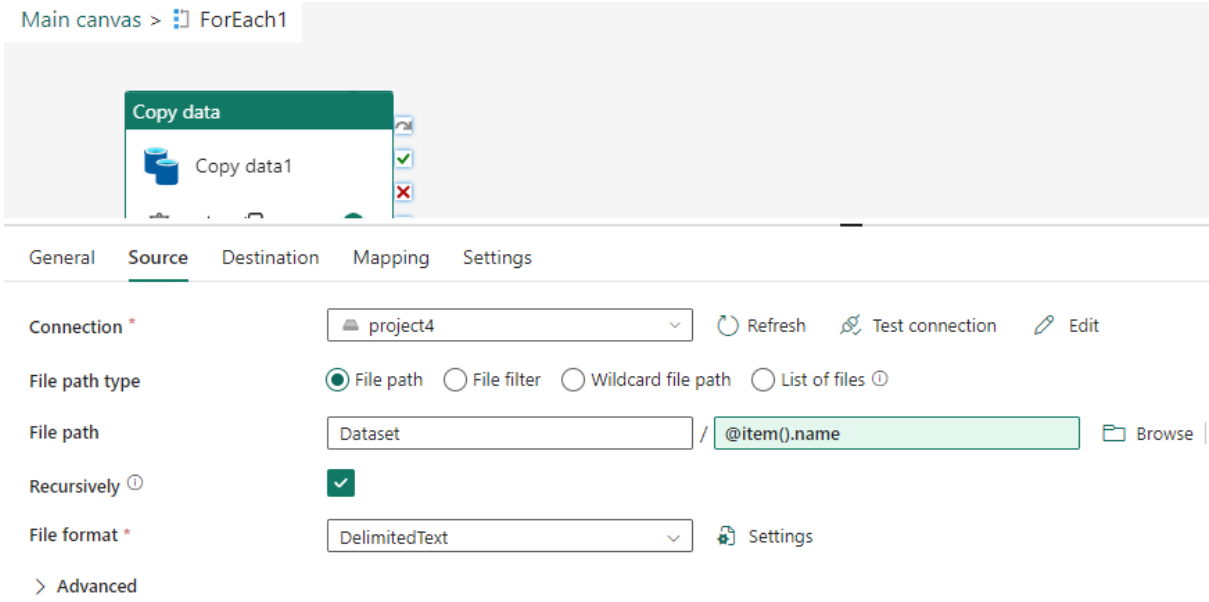
Add ForEach to the canvas and connect with get metadata activity on success.

→ForEach activity→settings→items→add dynamic content→under activity outputs→get metadata childitems



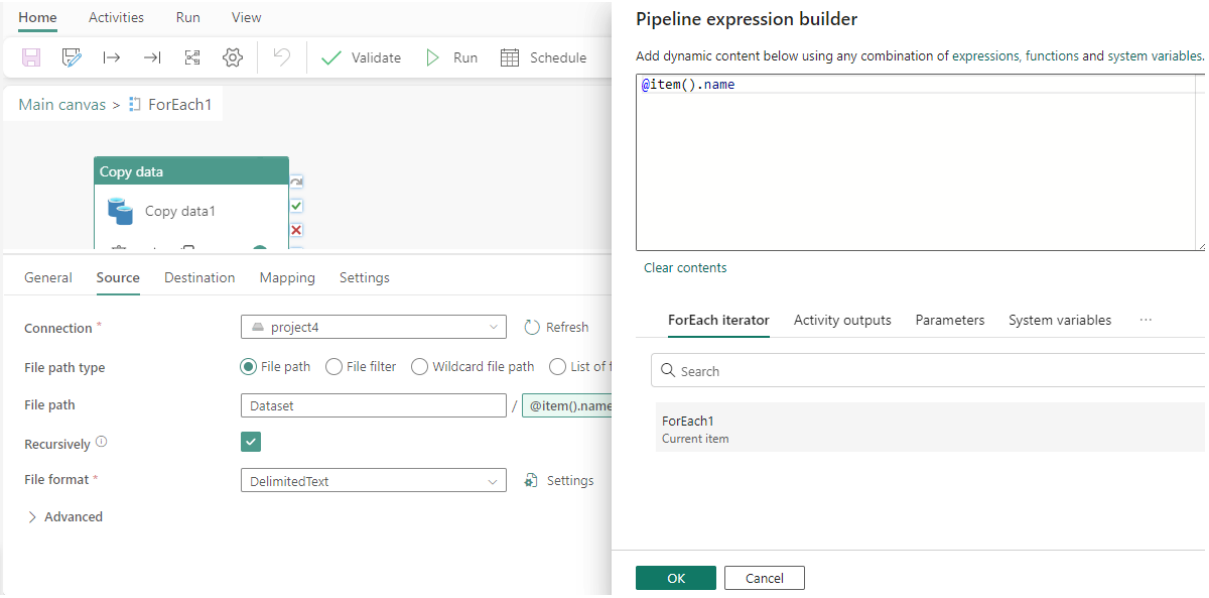
Add Copy activity Inside the **ForEach**

- Source:



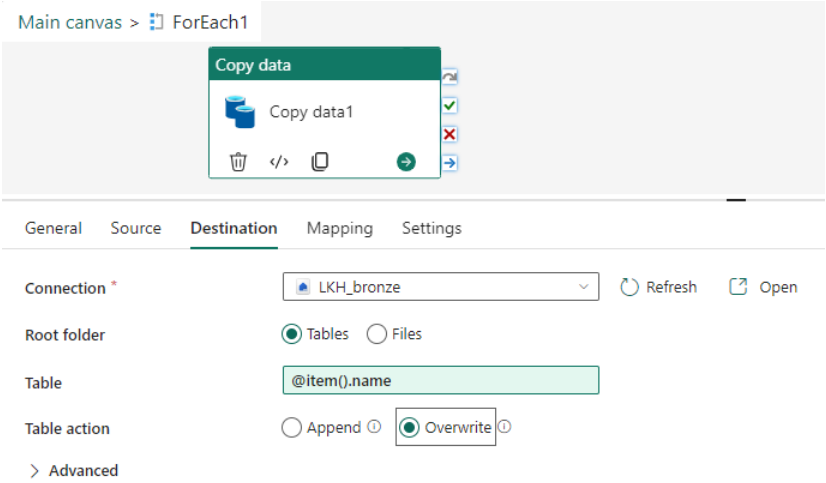
1. Connection: choose the connection that has been created for metadata activity.

2. Browse the file path, since copying multiple files at once created a parameter for file name



3. Filename: add dynamic content and select ForEach1
4. File format as DelimitedText(CSV).

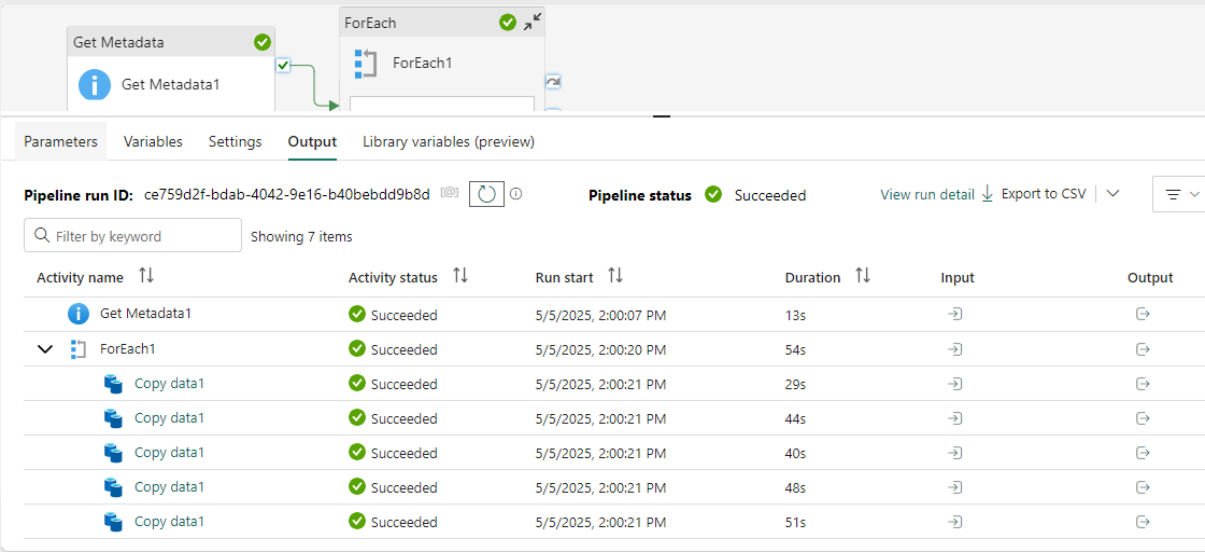
- Destination:



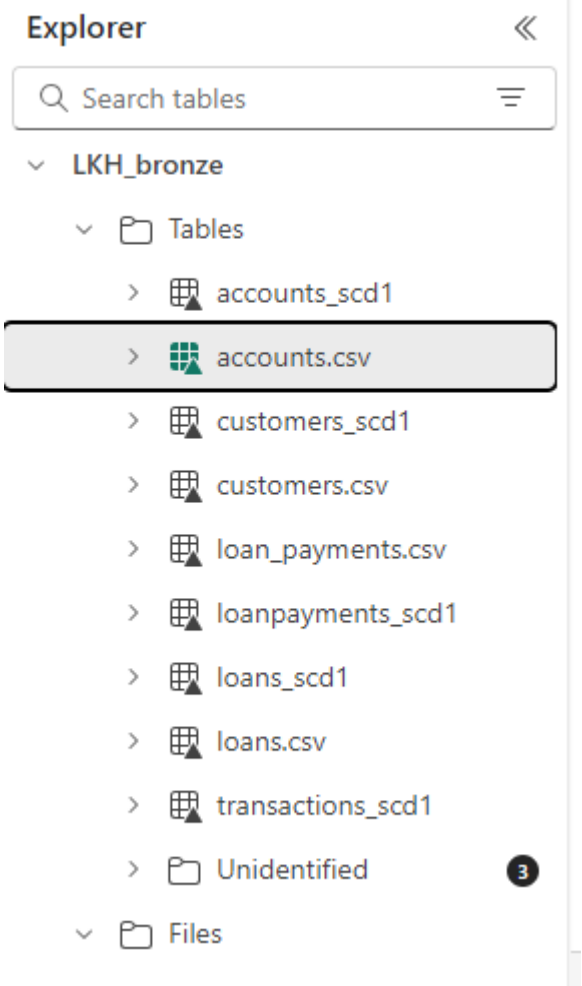
1. Connection: select the destination(sink) to copied
2. Select the root folder, since I want to store the data in tables
3. Table name: Add dynamic content→ForEach
4. Table action: overwrite.

Save and run

Output:



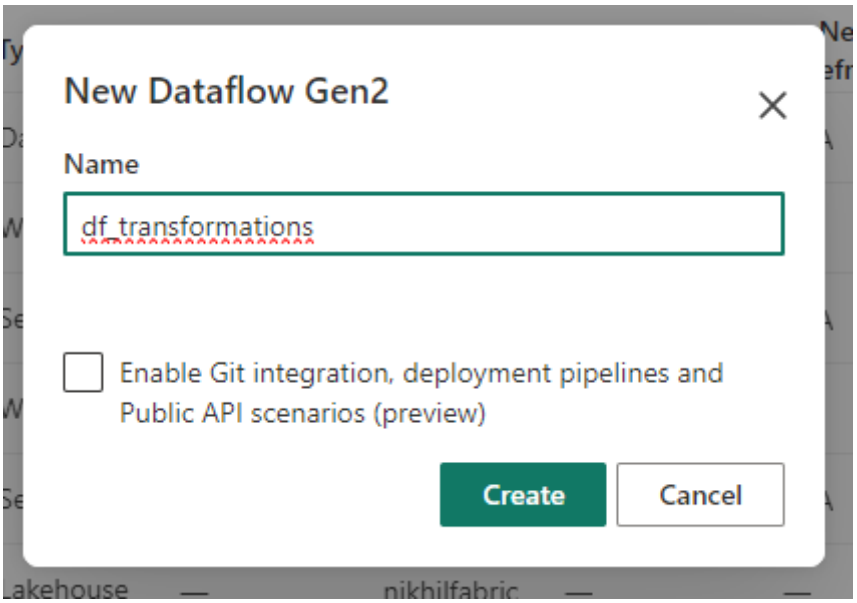
Data is written to LKH_Bronze.



Bronze to Silver:

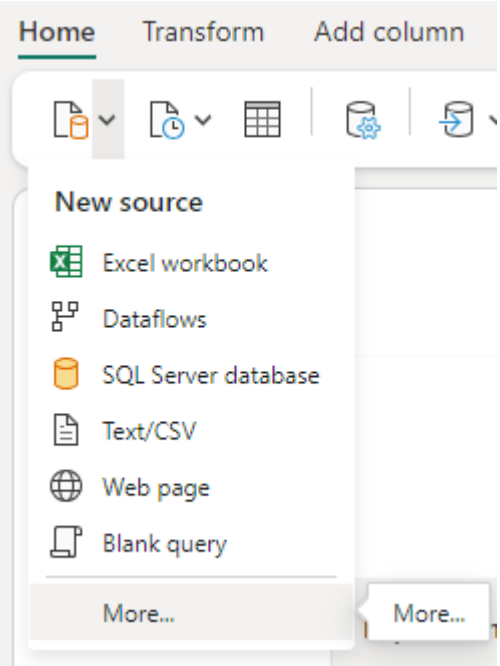
Data Transformations(cleaning data, remove nulls, deduplicates).

→Create a Dataflow in workspace.

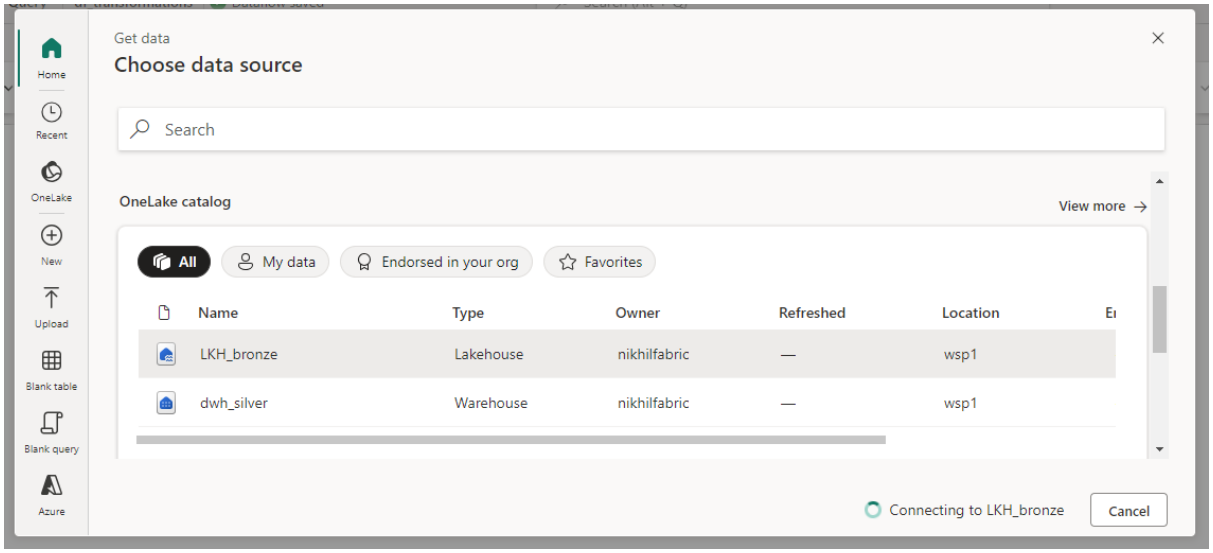


→create.

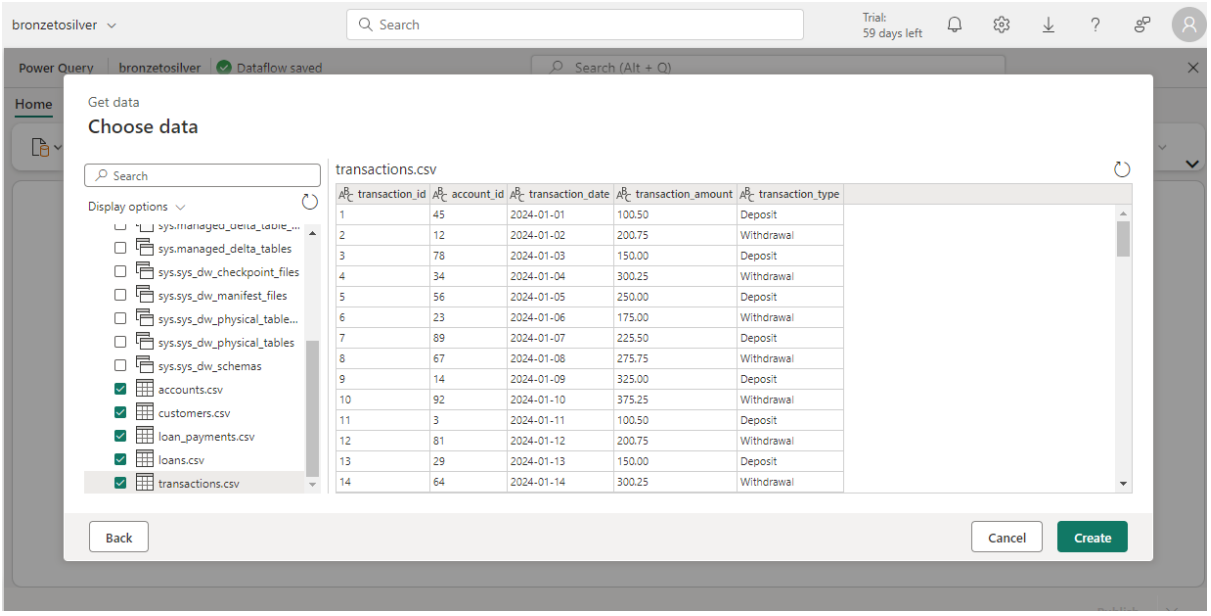
→Dataflow will open, from the left top get data→more



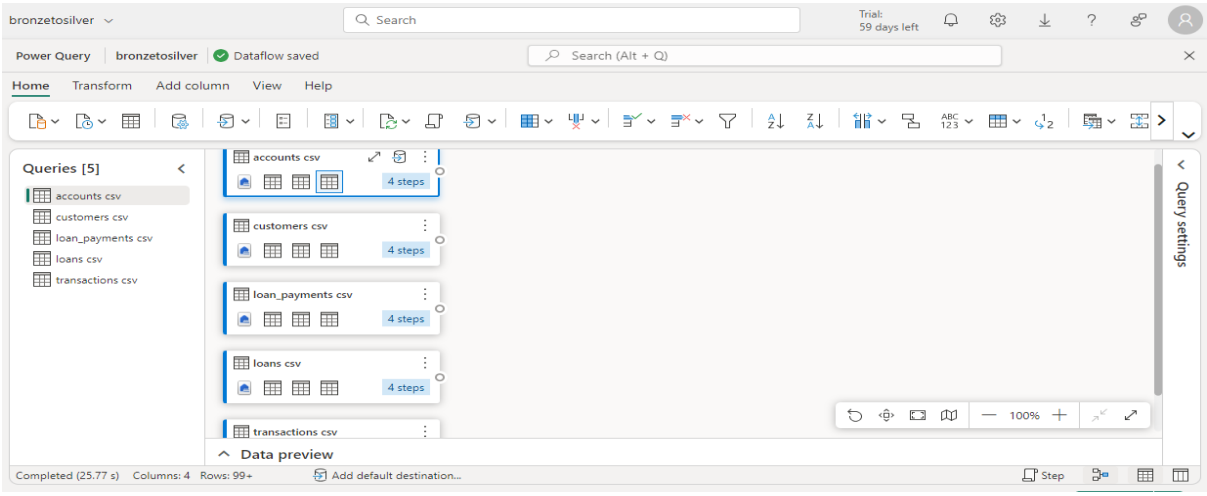
→choose the data source(since the data is LKH_bronze ,choose lakehouse as data source).



→select the lakehouse



Choose the Tables to be transformed and click create.

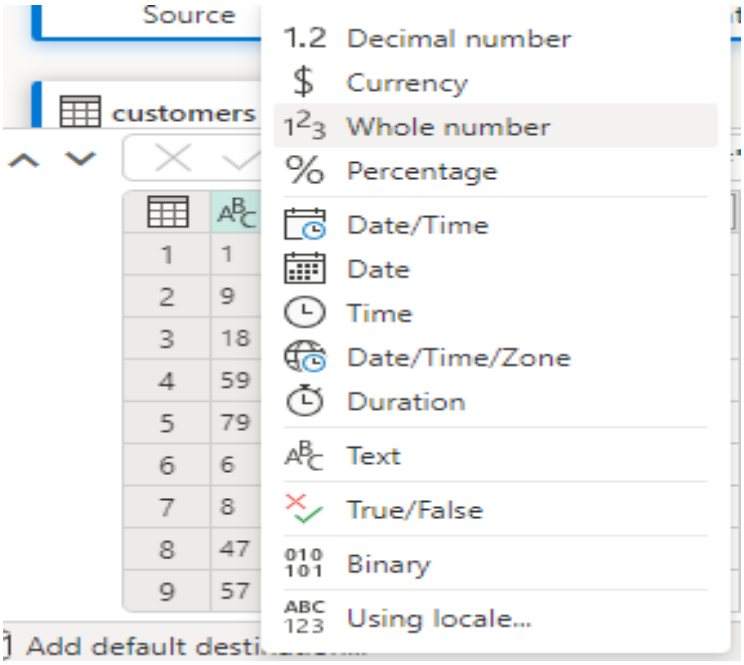


→click on accounts.csv and expand the stream.

	account_id	customer_id	account_type	balance
1	1	45	Savings	1000.50
2	9	14	Savings	900.25
3	18	5	Checking	1600.50
4	59	75	Savings	475.75
5	79	55	Savings	725.75
6	6	23	Checking	1200.50
7	8	67	Checking	2200.00
8	47	95	Savings	325.75
9	57	97	Savings	450.25

Data Type conversion: From the above table for account_id,customer_id and balance data type is text(string).

→To convert the type, click on the ABC to change the type→a data type list will appear and choose the appropriate data type.



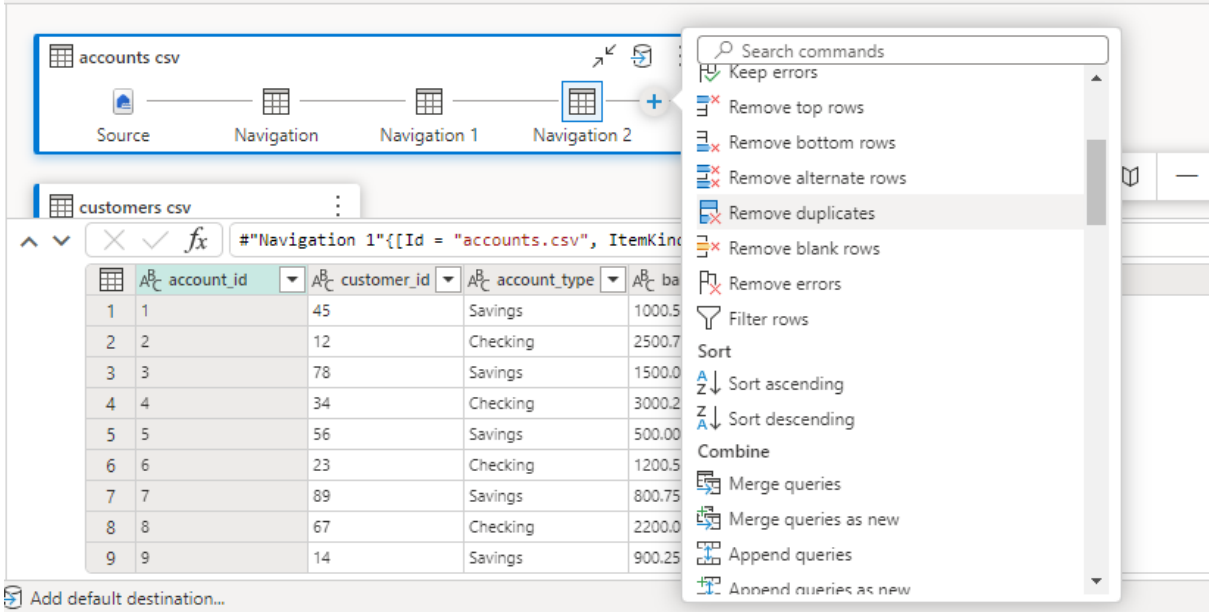
→select the whole number for account_id and customer_id

→select the decimal for balance.

Removing Duplicates: To remove the duplicates, select all the columns and then click on **+** from the stream.

From the options→select remove duplicates

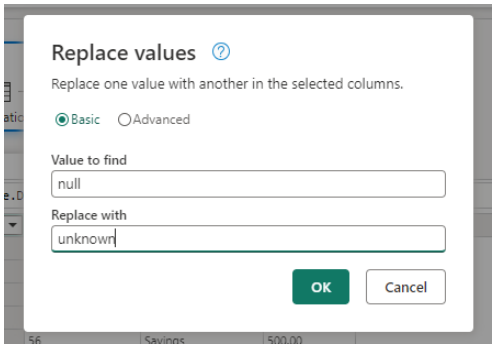
This function will remove the duplicate from the selected columns



Replacing NULL: To replace the null values in dataflow, click on the **+** from the stream and select the **replace values** or from the top in transform tab select the replace values

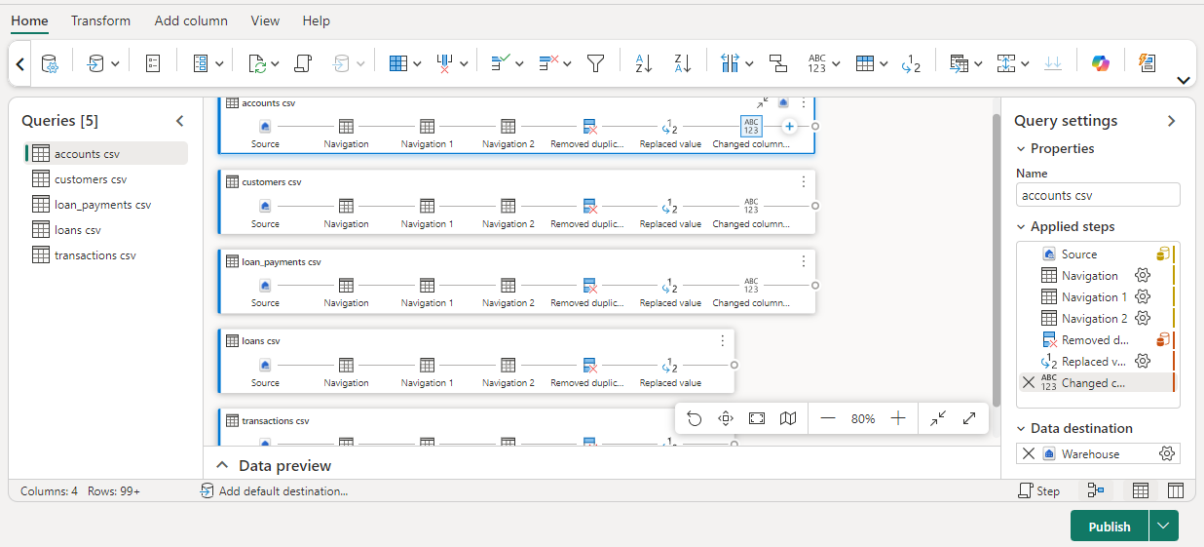
54	73	Andrew	Hamilton	7272 Maple Ave	Gravenhurst	ON	P1P0A1
55	30	Emily	Jordan	7979 Cypress Ave	North Bay	ON	P1B0A1
56	37	William	McDonald	8686 Maple Ave	Haileybury	*null*	*null*
57	30	Elizabeth	Stewart	2929 Elm St	Peterborough	ON	K9H0A1
58	33	John	Rogers	3232 Pine Rd	Timmins	ON	P4N0A1

From the above a record has null values



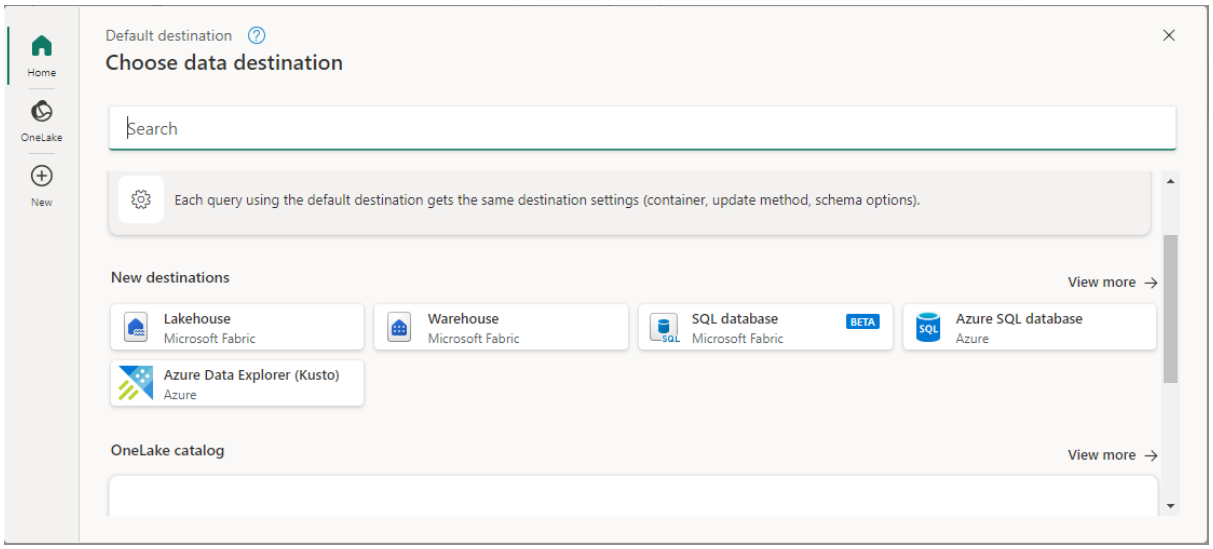
54	73	Andrew	Hamilton	7272 Maple Ave	Gravenhurst	ON	P1P0A1
55	80	Emily	Jordan	7979 Cypress Ave	North Bay	ON	P1B0A1
56	87	William	McDonald	8686 Maple Ave	Haileybury	unknown	unknown
57	30	Elizabeth	Stewart	2929 Elm St	Peterborough	ON	K9H0A1
58	33	John	Rogers	3232 Pine Rd	Timmins	ON	P4N0A1

Null values has been replaced with unknow from the above.

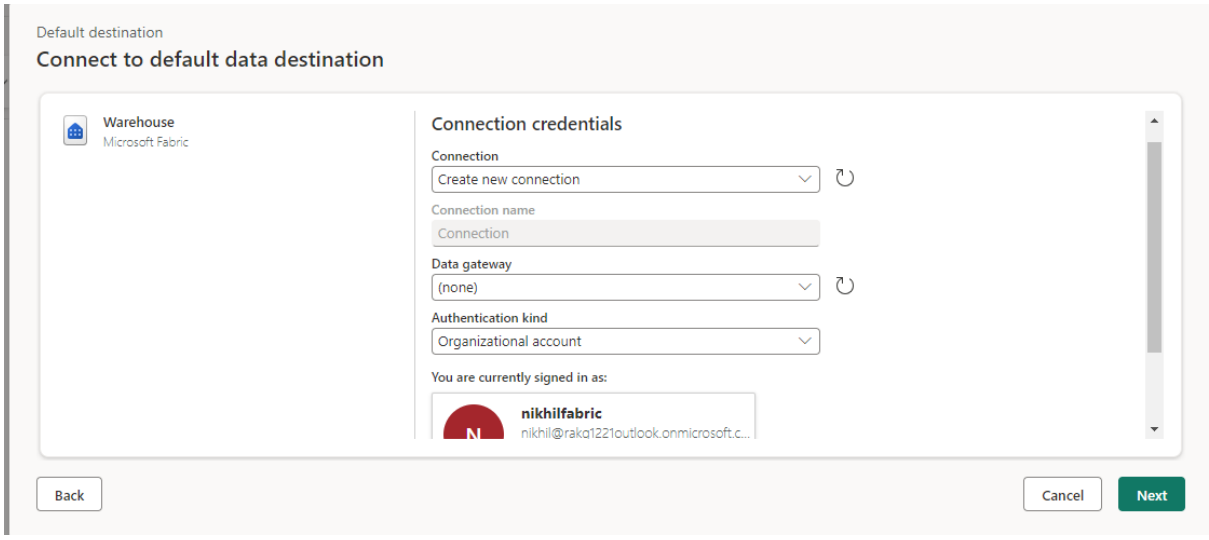


Above is the transformations overview.

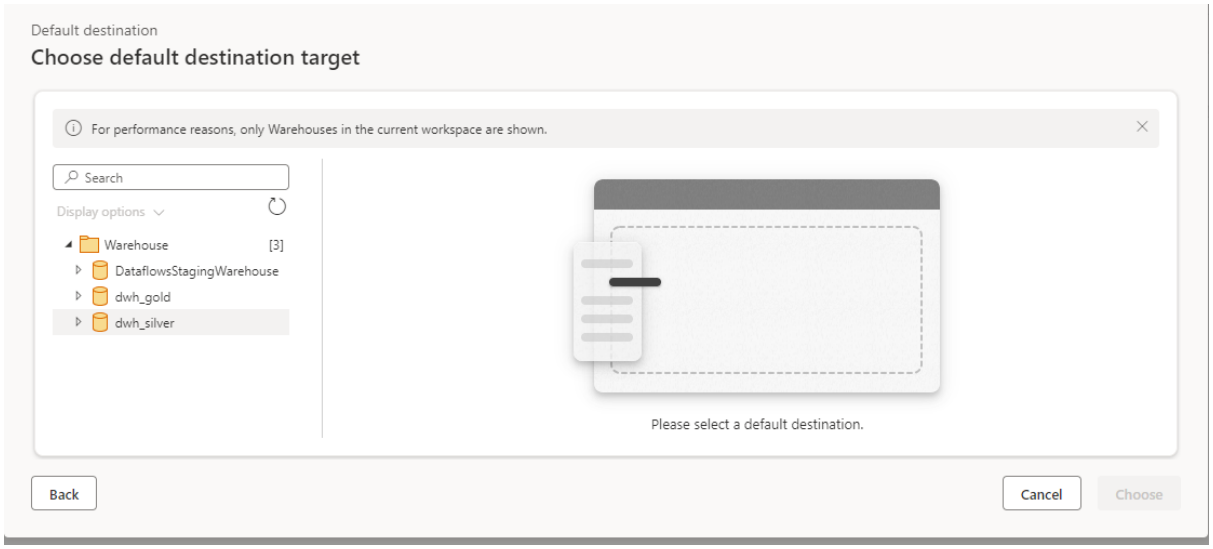
Add Destination : add destination to the each stream by clicking on the three dots or at the bottom Add default destination



Choose the datawarehouse as destination



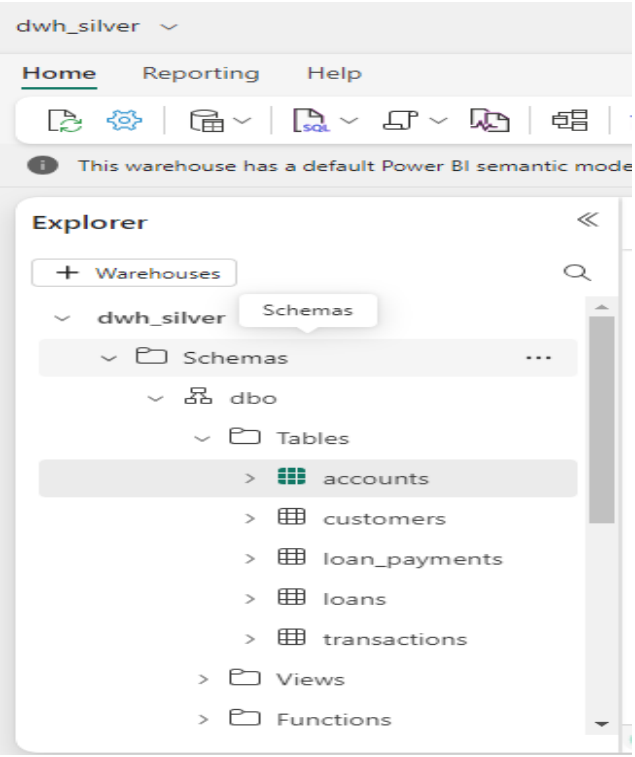
Create a connection with datawarehouse.



Choose the datawarehouse from the options and click choose.

The Publish the dataflow, the data will be written to datawarehouse.

Output

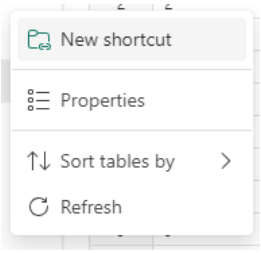


Silver to Gold : Using the Notebook

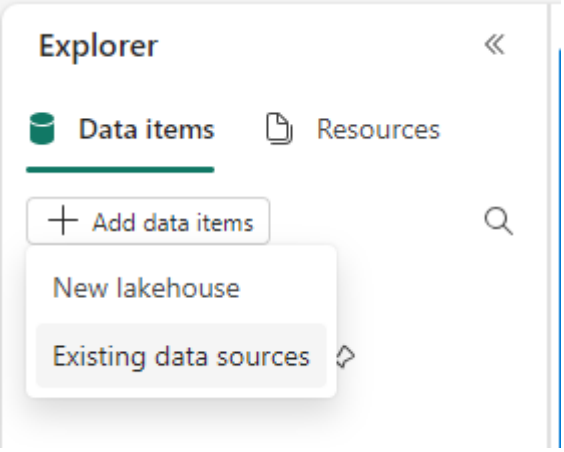
→Create a notebook in workspace.

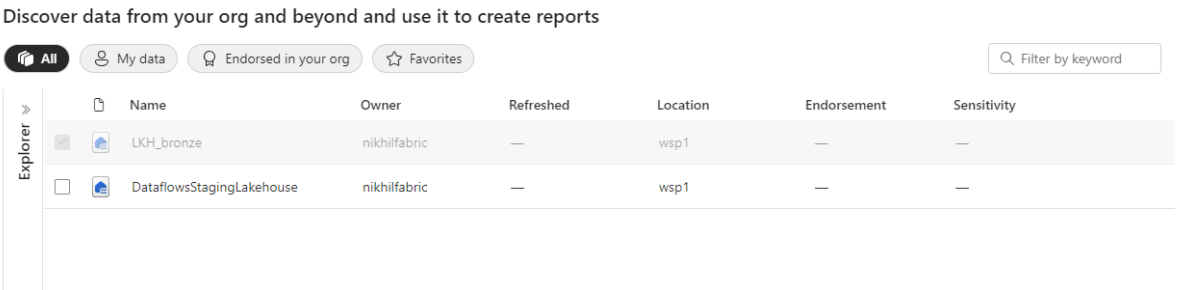
→before accessing the notebook, create a shortcut in LKH_bronze for dwh_silver. Since, notebook cannot access the data from the datawarehouse directly.

→creating shortcut in LKH_bronze, click on table menu→select new shortcut→select internal sources and datawarehouse.

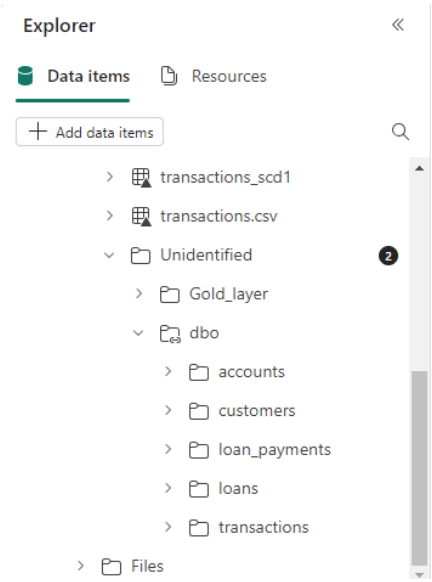


→open the notebook and attach the LKH_bronze from explorer tab→add items→existing data sources





From the option choose the lakehouse and connect.



Lakehouse has been attached to notebook and data can be retrieved from here directly.

→Turn on the session from the connect on top.

Implementing SCD Type 1 Logic on Tables.

→Accounts,

1. Create a SQL table

```
%%sql
CREATE table if not EXISTS accounts_scd1(
account_id int,
customer_id int,
account_type varchar(50),
balance decimal(12,2),
hashkey bigint,
createdby varchar(50),
createddate timestamp,
updatedby varchar(50),
updateddate timestamp
)
using DELTA
LOCATION 'Tables/Gold_layer/accounts_scd1'
```

```
%%sql
CREATE table if not EXISTS accounts_scd1(
account_id int,
customer_id int,
account_type varchar(50),
balance decimal(12,2),
hashkey bigint,
createdby varchar(50),
createddate timestamp,
updatedby varchar(50),
updateddate timestamp
)
using DELTA
LOCATION 'Tables/Gold_layer/accounts_scd1'
```

✓ - Command executed in 21 sec 122 ms by nikhilfabric on 11:43:52 PM, 5/05/25

Gold_layer is kind of folder in LKH_bronze.

→define source and target path by using a variable. Read the data from the source.

```
src_path='Tables/dbo/accounts'
tgt_path='Tables/Gold_layer/accounts_scd1'
acc_src=spark.read.format('delta').load(src_path)
```

✓ - Command executed in 4 sec 631 ms by nikhilfabric on 10:34:57 AM, 5/06/25

→import pyspark.sql.functions, to perform operations

```
from pyspark.sql.functions import *
```

✓ - Command executed in 284 ms by nikhilfabric on 10:35:00 AM, 5/06/25

→now add the hashkey column to the source data using withColumn,crc32 and concat.

```
acc_src=acc_src.withColumn('hashkey',crc32(concat(*acc_src.columns)))
```

✓ - Command executed in 272 ms by nikhilfabric on 10:35:03 AM, 5/06/25

→Now import the deltatables

```
from delta.tables import DeltaTable
deltatable=DeltaTable.forPath(spark,tgt_path)
deltatable.toDF().show()
```

✓ - Command executed in 6 sec 164 ms by nikhilfabric on 10:35:17 AM, 5/06/25 PySpark (Python)

```
+----------+-----------+------------+-------+----------+---------+--------------------+---------+-----------------
---+
|account_id|customer_id|account_type|balance|   hashkey|createdby|         createddate|updatedby|
updateddate|
+----------+-----------+------------+-------+----------+---------+--------------------+---------+-----------------
---+
```

Imports the DeltaTable class from the Delta Lake library.

Creates a DeltaTable object pointing to the Delta table stored at tgt_path.

→join the source dataframe with delta table on a matching condition using **anti join**. And select all columns from source.

```
acc_src=acc_src.alias("acc").join(deltatable.toDF().alias("tgt"),\
                              ((col("acc.account_id")==col("tgt.account_id"))&\
                              (col("acc.hashkey")==col("tgt.hashkey"))),"anti").select(col("acc.*"))
```

✓ - Command executed in 293 ms by nikhilfabric on 10:35:22 AM, 5/06/25 PySpark (Python)

→Now merge the delta table with source dataframe on a condition.

```
deltatable.alias("tgt").merge(acc_src.alias("acc"),"tgt.account_id=acc.account_id")\
                        .whenMatchedUpdate(set={"tgt.account_id":"acc.account_id","tgt.customer_id":"acc.customer_id",\
                        "tgt.account_type":"acc.account_type","tgt.balance":"acc.balance","tgt.hashkey":"acc.hashkey",\
                        "tgt.updatedby":lit("fabric"),"tgt.updateddate":current_timestamp()})\
                        .whenNotMatchedInsert(values={"tgt.account_id":"acc.account_id","tgt.customer_id":"acc.customer_id",\
                        "tgt.account_type":"acc.account_type","tgt.balance":"acc.balance","tgt.hashkey":"acc.hashkey",\
                        "tgt.createdby":lit("fabric"),"tgt.createddate":current_timestamp(),\
                        "tgt.updatedby":lit("fabric"),"tgt.updateddate":current_timestamp()})\
                        .execute()
```

✓ - Command executed in 7 sec 843 ms by nikhilfabric on 10:35:32 AM, 5/06/25 PySpark (Pytho

Output

Accounts

```
display(spark.read.format('delta').load('Tables/Gold_layer/accounts_scd1'))
```

[29] ✓ 3 sec - Command executed in 3 sec 374 ms by nikhilfabric on 3:35:56 PM, 5/06/25 PySpark (Python)

Spark jobs (6 of 6 succeeded) Resources

Table | New chart | 9 columns, 100 rows

Table view | Download | Search

	account_id	customer_id	account_type	balance	hashkey	createdby	createddate	updatedby	updatedd
1	1	45	Savings	1000.50	2454403084	fabric	2025-05-06 03:1...	fabric	2025-05-
2	9	14	Savings	900.25	1397533172	fabric	2025-05-06 03:1...	fabric	2025-05-
3	18	5	Checking	1600.50	544941373	fabric	2025-05-06 03:1...	fabric	2025-05-
4	59	75	Savings	475.75	1084664362	fabric	2025-05-06 03:1...	fabric	2025-05-
5	79	55	Savings	725.75	1919448738	fabric	2025-05-06 03:1...	fabric	2025-05-
6	6	23	Checking	1200.50	589336936	fabric	2025-05-06 03:1...	fabric	2025-05-
7	8	67	Checking	2200.00	3401041467	fabric	2025-05-06 03:1...	fabric	2025-05-
8	47	95	Savings	325.75	3742642303	fabric	2025-05-06 03:1...	fabric	2025-05-
9	57	97	Savings	450.25	1548801870	fabric	2025-05-06 03:1...	fabric	2025-05-
10	66	26	Checking	6700.50	372242038	fabric	2025-05-06 03:1...	fabric	2025-05-
11	40	19	Checking	4100.00	2070805942	fabric	2025-05-06 03:1...	fabric	2025-05-

Inspect

Customers

```
display(spark.read.format('delta').load('Tables/Gold_layer/customers_scd1'))
```

[30] ✓ 3 sec - Command executed in 3 sec 700 ms by nikhilfabric on 3:37:04 PM, 5/06/25 PySpark (Pytl

Spark jobs (6 of 6 succeeded) Resources

Table | New chart | 12 columns, 87 rows

Table view | Download | Search

	customer_id	first_name	last_name	address	city	state	zip	hashkey	createdby	created
1	5	David	Wilson	202 Birch Blvd	Vancouver	BC	V5K0A1	3284019540	databricks	2025-05
2	42	Charlotte	Richardson	4141 Beech Dr	Newmarket	ON	L3Y0A1	2954704707	databricks	2025-05
3	49	Joshua	Bennett	4848 Spruce...	Beaverton	ON	L0K0A1	1307334809	databricks	2025-05
4	52	Abigail	Henderson	5151 Cypres...	Mount Albert	ON	L0G0A1	569556118	databricks	2025-05
5	2	Jane	Smith	456 Maple A...	Ottawa	ON	K1A0B1	3911254336	databricks	2025-05
6	4	Emily	Davis	101 Pine Rd	Calgary	AB	T2A0A1	165372536	databricks	2025-05
7	7	James	Martinez	606 Spruce Ln	Winnipeg	MB	R3C0A1	4278935663	databricks	2025-05
8	14	Sophia	Young	1313 Beech Dr	Yellowknife	NT	X1A0A1	1246741277	databricks	2025-05
9	75	Joshua	Sullivan	7474 Pine Rd	Bracebridge	ON	P1L0A1	3554568556	databricks	2025-05
10	11	Alexander	Thomas	1010 Willow...	St. John's	NL	A1A0A1	823092523	databricks	2025-05
11	20	Mia	Nelson	1919 Birch B...	London	ON	N6A0A1	1253444537	databricks	2025-05

Loans

```
[31]  display(spark.read.format('delta').load('Tables/Gold_layer/loans_scd1'))
```

3 sec - Running

PySpark (Pyth

Spark jobs In progress (2) Resources

Table | New chart | 10 columns, 100 rows

Table view | Download | Search

	loan_id	customer_id	loan_amount	interest_rate	loan_term	hashkey	createdby	createddate	updated
1	5	56	25000.0	5.0	36	951778087	databricks	2025-05-06 13:5...	databric
2	25	66	25000.25	5.5	36	549737095	databricks	2025-05-06 13:5...	databric
3	42	36	20000.5	4.5	48	3521046828	databricks	2025-05-06 13:5...	databric
4	45	68	25000.25	5.0	36	1252029156	databricks	2025-05-06 13:5...	databric
5	54	42	30000.5	4.0	48	1545195748	databricks	2025-05-06 13:5...	databric
6	74	43	30000.5	4.5	48	333538238	databricks	2025-05-06 13:5...	databric
7	87	93	22500.75	6.5	60	3240117383	databricks	2025-05-06 13:5...	databric
8	53	86	15000.25	5.0	36	95809912	databricks	2025-05-06 13:5...	databric
9	92	44	20000.0	3.5	24	117152147	databricks	2025-05-06 13:5...	databric
10	4	34	30000.25	3.5	24	2847880128	databricks	2025-05-06 13:5...	databric
11	40	19	37500.0	3.0	24	3372912529	databricks	2025-05-06 13:5...	databric

Loanpayments

```
[32]  display(spark.read.format('delta').load('Tables/Gold_layer/loanpayments_scd1'))
```

2 sec - Command executed in 2 sec 402 ms by nikhilfabric on 3:38:46 PM, 5/06/25

PySpark (Pyt

Spark jobs (6 of 6 succeeded) Resources

Table | New chart | 9 columns, 100 rows

Table view | Download | Search

	payment_id	loan_id	payment_date	payment_amount	hashkey	createdby	createddate	updatedby	up
1	20	21	2024-01-20	1050.0	1615996424	databricks	2025-05-06 14:0...	databricks	20
2	61	72	2024-03-01	3100.0	3924611863	databricks	2025-05-06 14:0...	databricks	20
3	65	16	2024-03-05	3300.0	4085199564	databricks	2025-05-06 14:0...	databricks	20
4	83	14	2024-03-23	4200.0	2734147888	databricks	2025-05-06 14:0...	databricks	20
5	94	35	2024-04-03	4750.0	1343994555	databricks	2025-05-06 14:0...	databricks	20
6	33	64	2024-02-02	1700.0	3793101080	databricks	2025-05-06 14:0...	databricks	20
7	46	7	2024-02-15	2350.0	909840285	databricks	2025-05-06 14:0...	databricks	20
8	52	73	2024-02-21	2650.0	2180006131	databricks	2025-05-06 14:0...	databricks	20
9	12	33	2024-01-12	650.0	2585655648	databricks	2025-05-06 14:0...	databricks	20
10	58	39	2024-02-27	2950.0	618787123	databricks	2025-05-06 14:0...	databricks	20
11	74	15	2024-03-14	3750.0	3135475598	databricks	2025-05-06 14:0...	databricks	20

Transactions

```
[33]  display(spark.read.format('delta').load('Tables/Gold_layer/transactions_scd1'))
```

<1 sec - Command executed in 1 sec 585 ms by nikhilfabric on 3:39:41 PM, 5/06/25

PySpark (Python)

Spark jobs (2 of 2 succeeded) Resources

Table | New chart | 10 columns, 100 rows

Table view | Download | Search

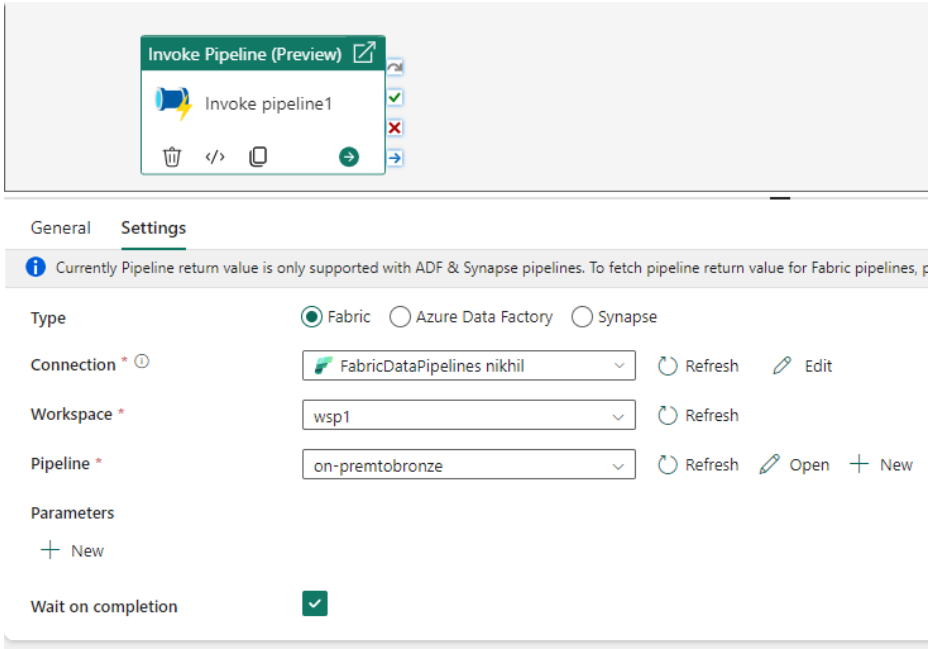
	transaction_id	account_id	transaction_date	transaction_amount	transaction_type	hashkey	createdby	createdda
1	38	15	2024-02-07	275.75	Withdrawal	1006322033	fabric	2025-05-
2	43	83	2024-02-12	150.0	Deposit	4257851425	fabric	2025-05-
3	54	42	2024-02-23	300.25	Withdrawal	3238602855	fabric	2025-05-
4	79	55	2024-03-19	325.0	Deposit	1630795787	fabric	2025-05-
5	92	44	2024-04-01	200.75	Withdrawal	1187297032	fabric	2025-05-
6	7	89	2024-01-07	225.5	Deposit	1987130936	fabric	2025-05-
7	12	81	2024-01-12	200.75	Withdrawal	3980785899	fabric	2025-05-
8	31	71	2024-01-31	100.5	Deposit	1417673545	fabric	2025-05-
9	66	26	2024-03-06	175.0	Withdrawal	3056144572	fabric	2025-05-
10	85	65	2024-03-25	250.0	Deposit	3638886954	fabric	2025-05-
11	35	62	2024-02-04	250.0	Deposit	717510064	fabric	2025-05-

Inspect

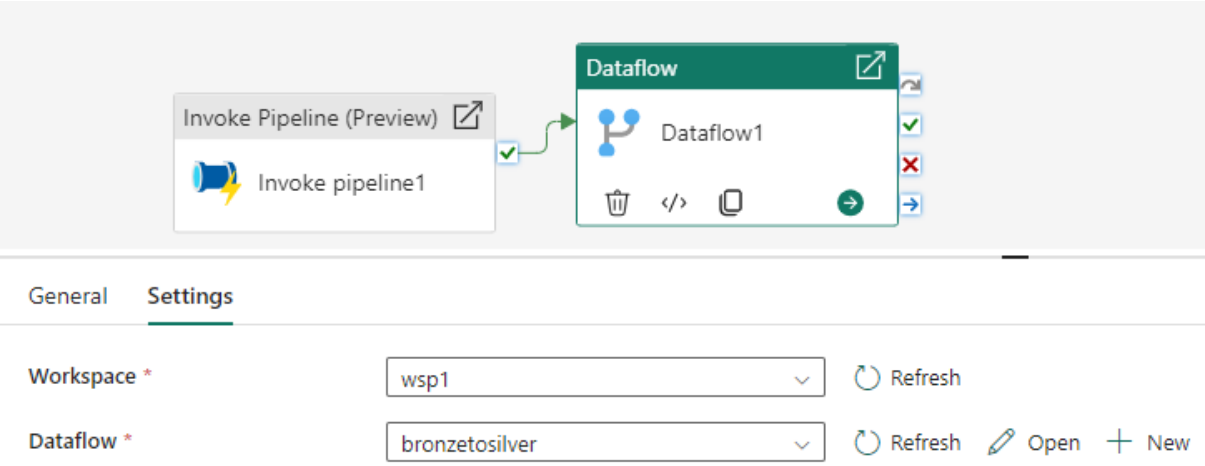
Scheduling Master Pipeline.

→Create a pipeline in workspace.

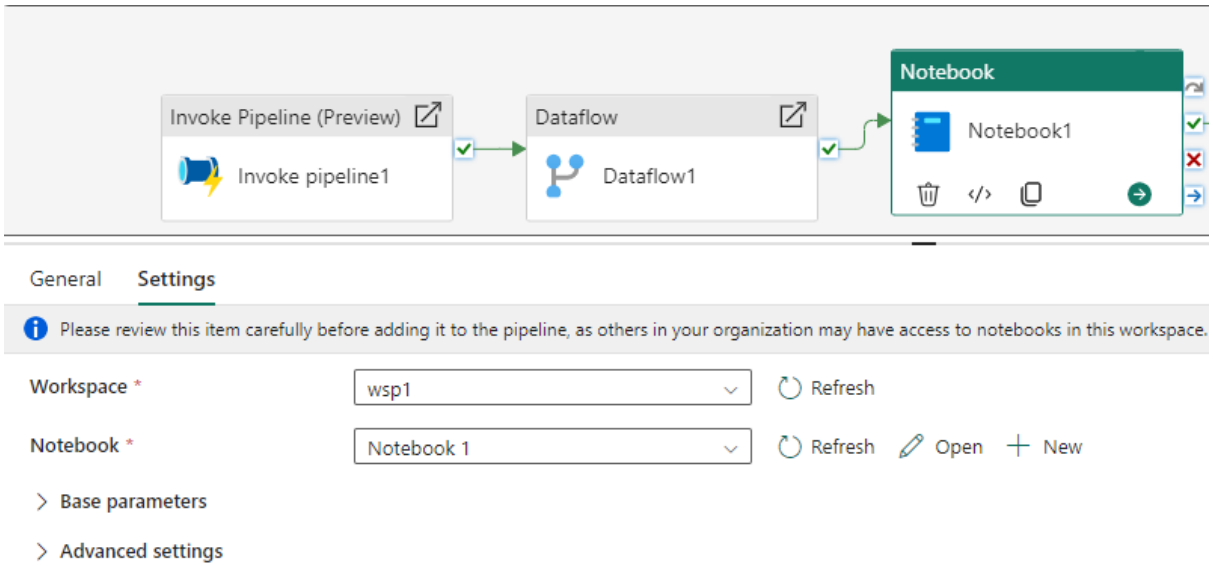
→under activities→select the **invoke pipeline**.



→on success connect to dataflow activity.

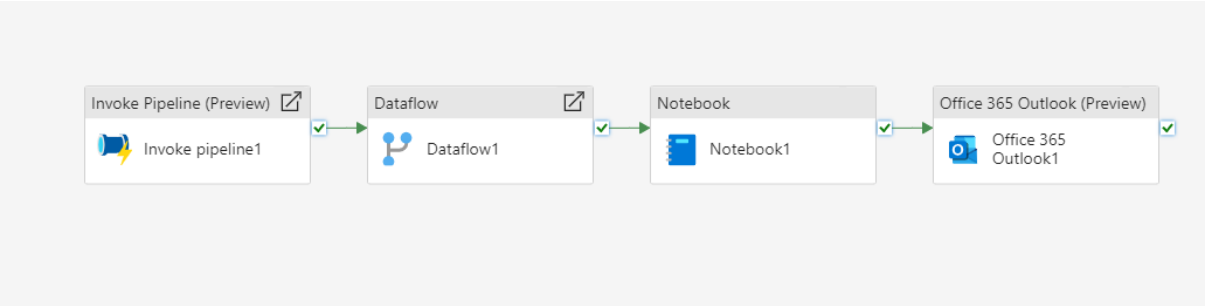


→on success connect to notebook.



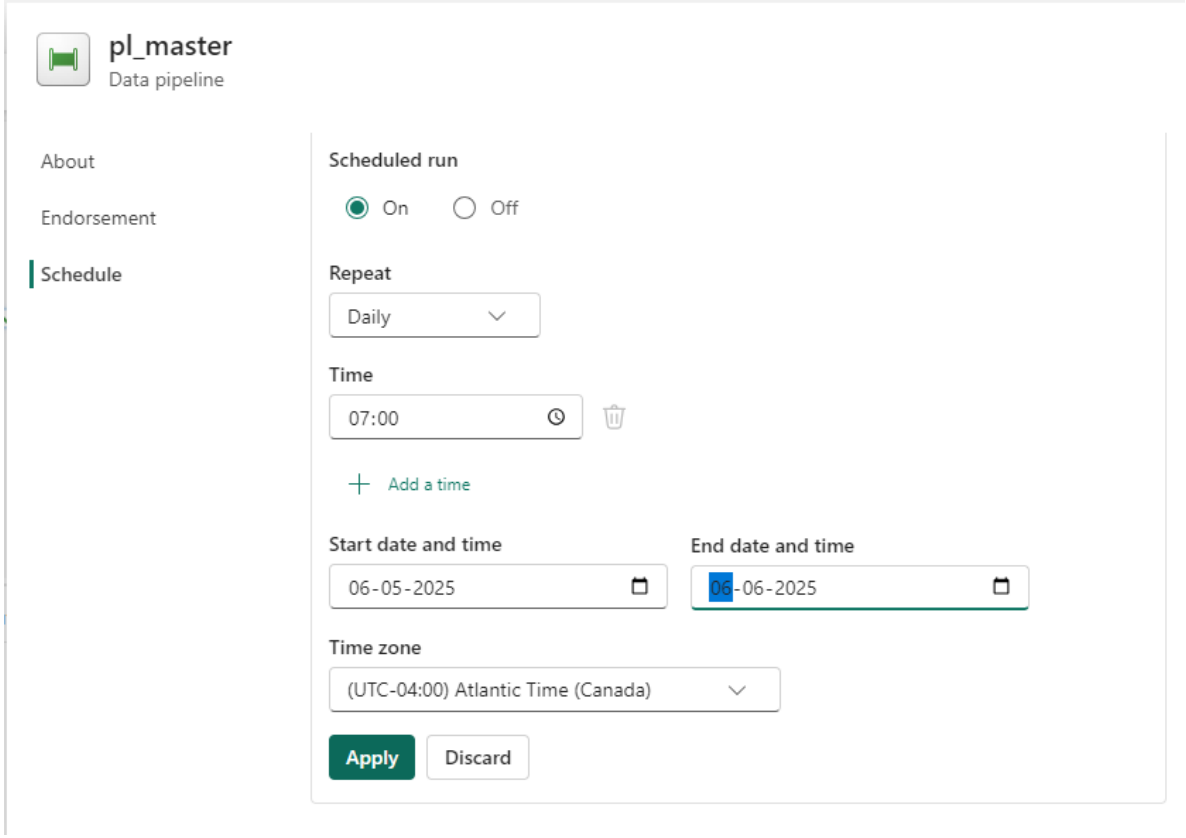
→finally connect to e-mail activity.

Overview of the master pipeline.



Schedule the above pipeline

→In the home tab, select schedule.



→apply.