Trino and Starburst Training Series: Data pipelines, views & data products

v1.0.0

Session 3 of 5: Full Series Information

Prior sessions

1. https://www.starburst.io/resources/creating-querying-data-lake-tables-on-demand/
2. https://www.starburst.io/resources/modern-table-formats-apache-iceberg-on-demand/

Table of Contents

Lab 1: Introduction and setup

Learning objectives

- Describe the lab scenarios and goals.
- Setup a free Starburst Galaxy account.
- Understand how to continue using Starburst Galaxy after the end of the lab.

Activities

1. Lab overview
2. Create a Starburst Galaxy account
3. Housekeeping items

Part 1: Overview of labs

You are a data engineer at Nintendo. You were asked to gather some data about Pokemon Go and help the marketing team figure out which Pokemon spawns are most common in the San Francisco Bay Area. You need to help both teams by discovering, transforming, and cleaning the data from multiple sources.

Step 1 - Purpose of labs

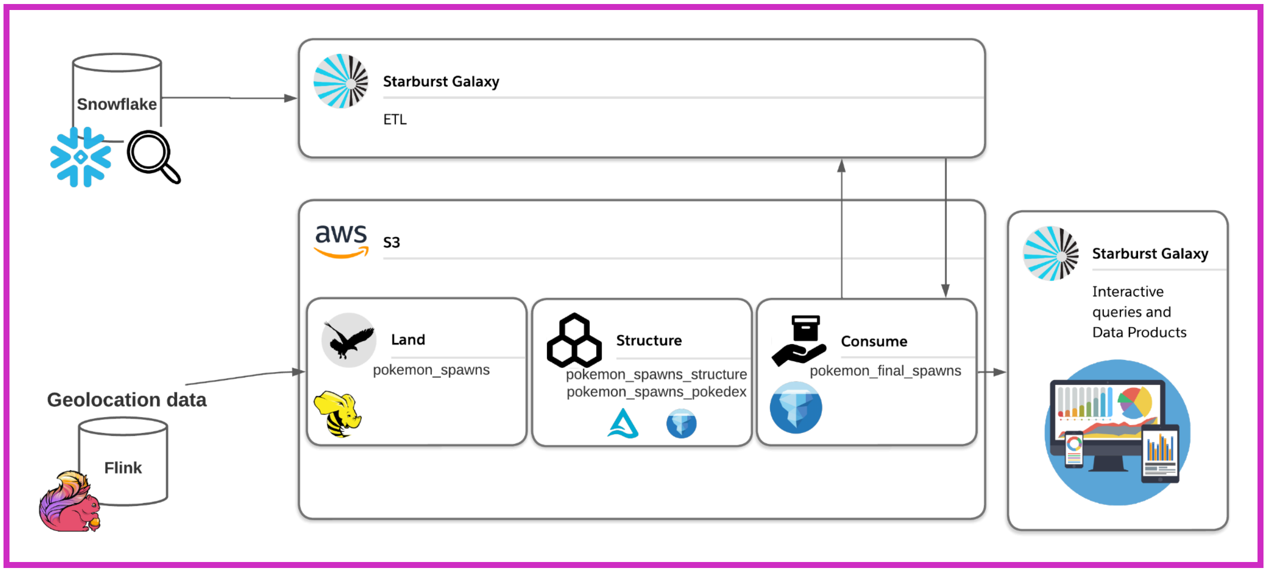
These labs use Pokemon Go data being ingested into S3, which contains the encounter information of the Pokemon including geolocation data of where the Pokemon spawned, and how long the Pokemon was at that location.

Importantly, you do not have any information about the Pokemon's abilities, that's all contained in the Pokedex in Snowflake. This has all the stats on your desired Pokemon including type_1, type_2, catch rate, and more.

Step 2 - Description of activities

To make sense of data from multiple sources, you will create a reporting structure in your data lake. First, you will use schema discovery to understand the data in your data lake. You will then use Starburst Galaxy to read the data in the land layer, then clean and optimize that data into more optimal ORC files in the structure layer. In the last step, you will join the geolocation information from AWS S3 with the Pokedex lookup table in Snowflake into a single table that is cleaned and ready to be utilized by our teams. After completing the discovery, location, governance, and query stages, you will end the lab by creating data products, which package the dataset in a curated way for easy consumption.

You will also be introduced to Gravity and Great Lakes connectivity in Starburst Galaxy, which are two awesome features that make it easy to run data lake analytics. Both these features will be demonstrated throughout the lab guide.



Step 3 - Data challenge

This data challenge involves two key missions:

- Create a final table output combining data from both structure tables.
- Create a data product answering two specific business questions from the marketing department.
    a. What are the easiest and most popular Pokemon to catch in San Francisco by Type_1?
    b. Find the total number of Pokemon caught for each Type_1 and Type_2 pairing. Also, find the average catch rate.

Note: Easiest is defined by having a high catch rate. A high catch rate is greater than or equal to 100. Also consider that in the structure layer, you filtered out data that did not exist in the San Francisco Bay Area.

Part 2: Create a Starburst Galaxy account

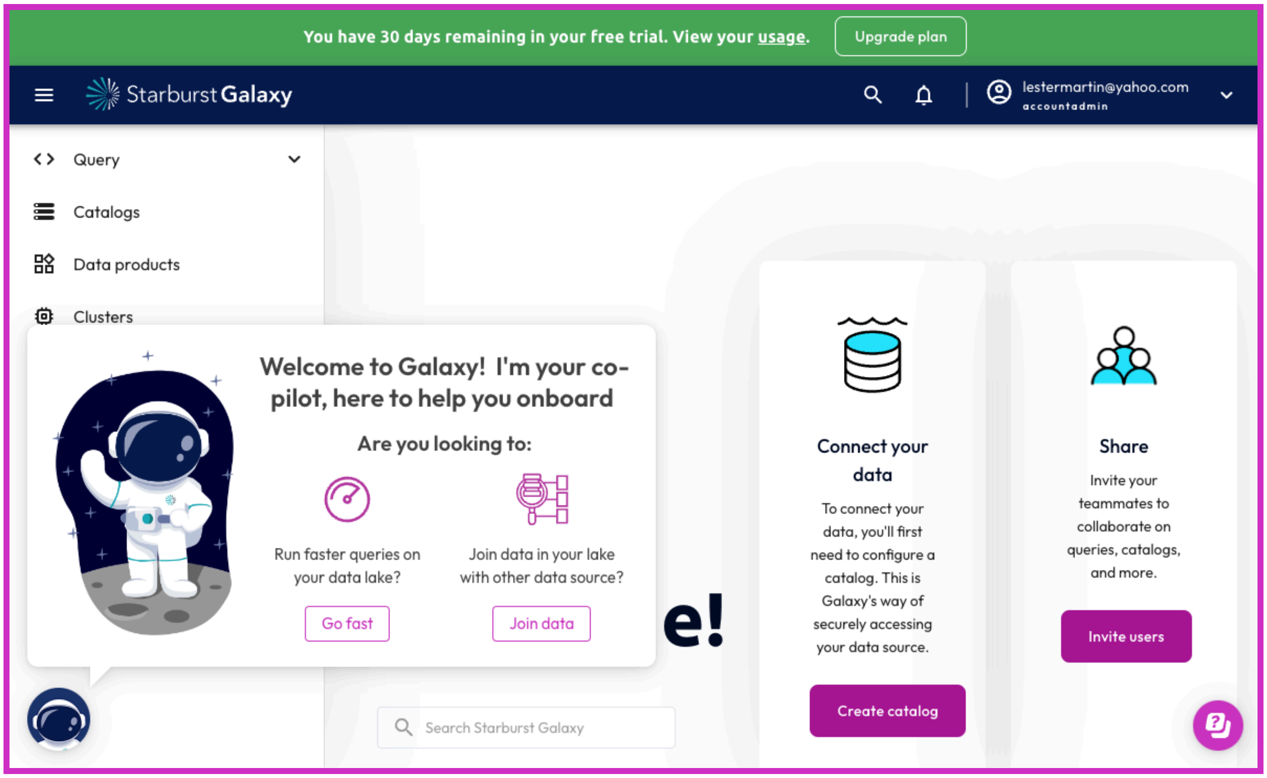
For each webinar in the 5-part series, you will be using your own Starburst Galaxy environment. ***If you have already registered for Starburst Galaxy, you may skip to Part 3.***

To sign up for Starburst Galaxy, follow the instructions on the free registration page at https://www.starburst.io/platform/starburst-galaxy/start/.

Note: You will receive an “invitation” email. Please check your spam or junk folder if it does not immediately arrive in your inbox.

After you have entered your confirmation code, set a password, and selected your new domain name, you will be presented with a series of questions about your desired usage for Starburst Galaxy. Complete these with whatever you choose to share.

Eventually, you will likely be presented with a page similar to the following screenshot.



You have 30 days remaining in your free trial. View your usage.

Welcome to Galaxy! I'm your co-pilot, here to help you onboard

Are you looking to:

Run faster queries on your data lake?

Join data in your lake with other data source?

Connect your data

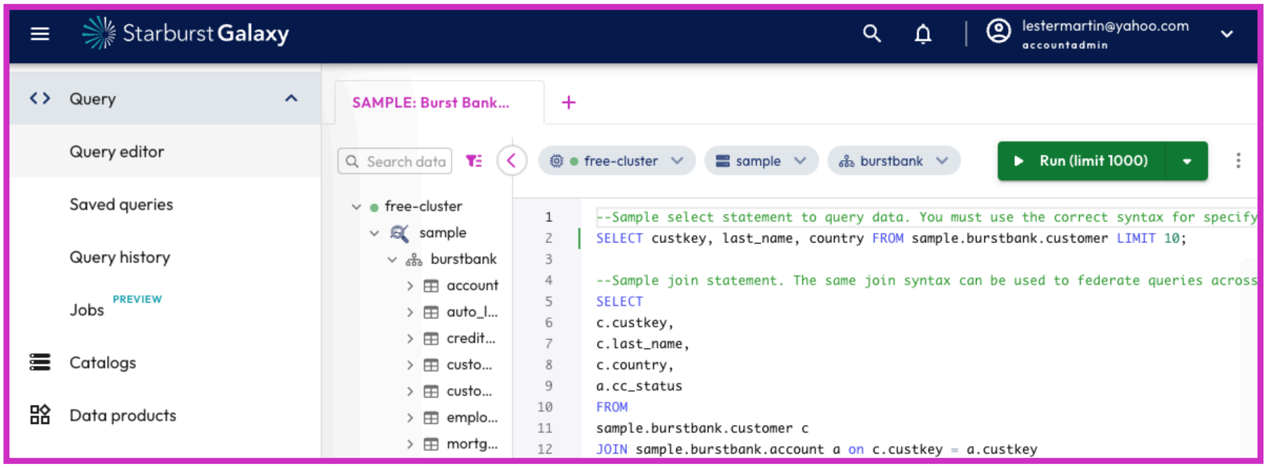
To connect your data, you'll first need to configure a catalog. This is Galaxy's way of securely accessing your data source.

Share

Invite your teammates to collaborate on queries, catalogs, and more.

Click on the astronaut helmet icon in the lower-left to silence the pop-up coming from it.

At this point, you should see something similar to this to indicate you are fully configured.



```
--Sample select statement to query data. You must use the correct syntax for specify
SELECT custkey, last_name, country FROM sample.burstbank.customer LIMIT 10;

--Sample join statement. The same join syntax can be used to federate queries across
SELECT
c.custkey,
c.last_name,
c.country,
a.cc_status
FROM
sample.burstbank.customer c
JOIN sample.burstbank.account a on c.custkey = a.custkey
```

Part 3: Housekeeping

As part of the Galaxy Lunch and Lab, the credentials for Amazon S3 and Snowflake will be available for up to 1 week. It is critical to understand that time, **YOU WILL BE UNABLE TO RUN ANY QUERIES AGAINST THE TWO CATALOGS CREATED IN THIS LAB**.

If you want to continue exploring Starburst Galaxy, here are some other free projects and helpful links you can utilize with your Starburst Galaxy account:

- Federate multiple data sources tutorial
- Starburst Academy
    - Starburst Galaxy courses
    - Data foundations courses
    - Learn SQL courses
    - Starburst foundations
- Starburst Galaxy documentation
- Near Real-Time Ingestion tutorial

Lab 2: Connect to data sources

Learning objectives

- Describe the process for creating catalogs that connect AWS S3 and Snowflake.
- Demonstrate how to create a cluster in Starburst Galaxy.

Activities

1. Create Amazon S3 catalog
2. Create Snowflake catalog
4. Create a cluster
5. Grant location-based access control

Part 1: Create Amazon S3 catalog

Objective

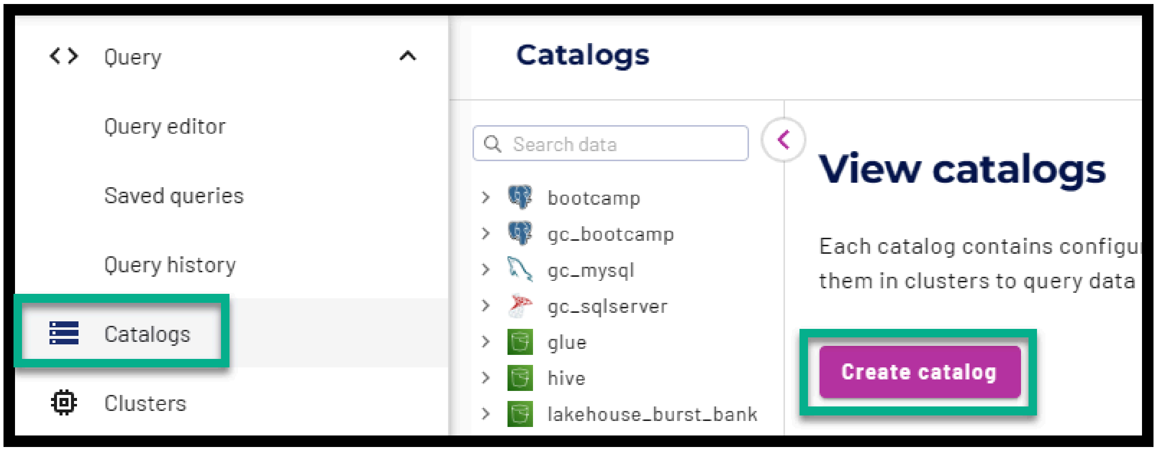
You're going to begin by setting up an AWS S3 catalog in Starburst Galaxy and connect the Pokemon spawns geolocation data.

Step 1 - Sign in and verify your role

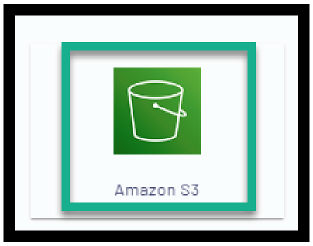
Sign in to Starburst Galaxy. Use the account credentials you previously created. In the upper right corner of the screen, confirm that your role is set as `accountadmin`.

Step 2 - Create Amazon S3 catalog

Click **Catalogs** in the menu on the left and then click the **Create catalog** button.

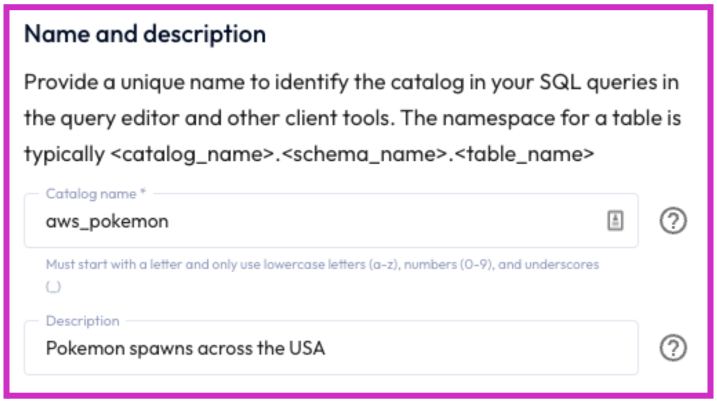


Click the **Amazon S3** tile.



Use the information below to configure your catalog.

Catalog name: `aws_pokemon`
Description: `Pokemon spawns across the USA`



Name and description

Provide a unique name to identify the catalog in your SQL queries in the query editor and other client tools. The namespace for a table is typically <catalog_name>.<schema_name>.<table_name>

Catalog name *
aws_pokemon

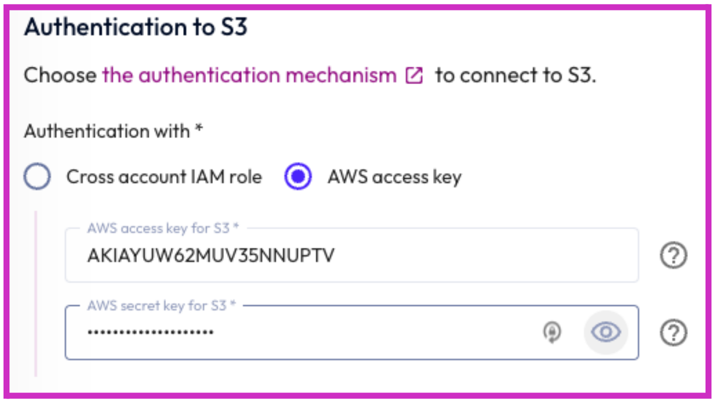
Must start with a letter and only use lowercase letters (a-z), numbers (0-9), and underscores (_)

Description
Pokemon spawns across the USA

Authentication with: select the radio button **AWS access key**

AWS access key for S3: `AKIAYUW62MUV35NNUPTV`
AWS secret key for S3: `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`

Note: These AWS credentials will only be operational through the weekend following the webinar. You will not be able to utilize this catalog beyond that point and should remove it from your Galaxy configuration.



Authentication to S3

Choose the authentication mechanism to connect to S3.

Authentication with *

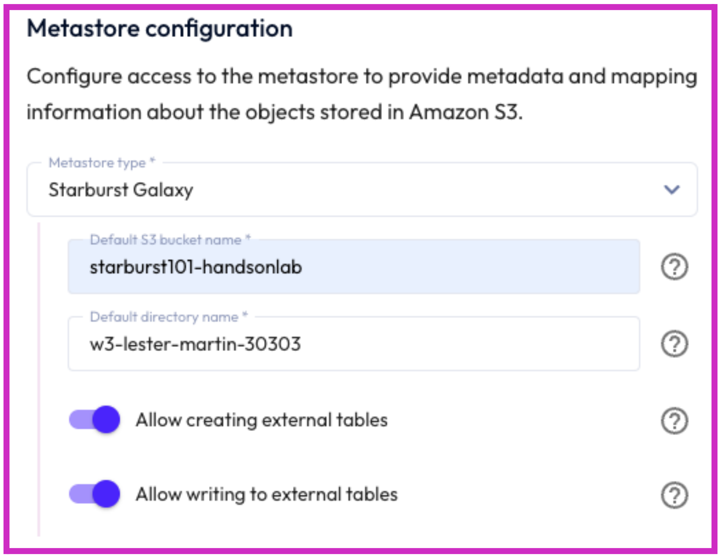
○ Cross account IAM role ● AWS access key

AWS access key for S3 *
AKIAYUW62MUV35NNUPTV

AWS secret key for S3 *
••••••••••••••••••••

Metastore type: select the radio button **Starburst Galaxy**
Default S3 bucket name: `starburst101-handsonlab`
Default directory name: w3-fname-lname-postalcode (ex: `w3-lester-martin-30303`)

Allow creating external tables: enable the slider
Allow writing to external tables: enable the slider



Metastore configuration

Configure access to the metastore to provide metadata and mapping information about the objects stored in Amazon S3.

Metastore type *: Starburst Galaxy

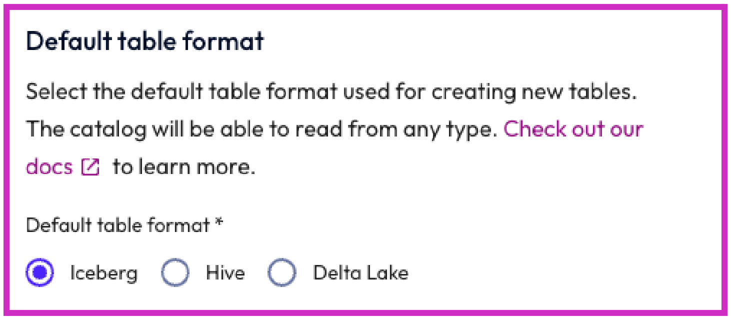
Default S3 bucket name *: starburst101-handsonlab

Default directory name *: w3-lester-martin-30303

Allow creating external tables: enabled

Allow writing to external tables: enabled

Default table format: ensure the radio button is selected to **Iceberg**



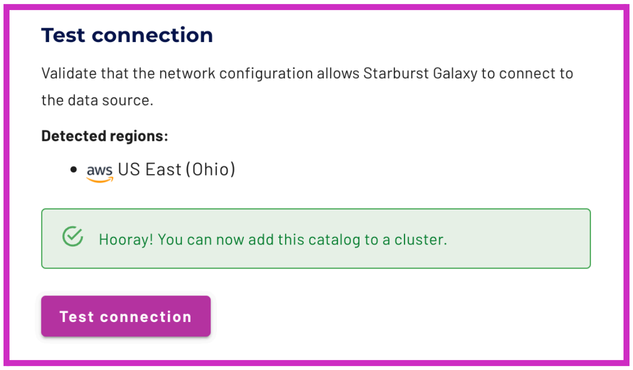
Default table format

Select the default table format used for creating new tables. The catalog will be able to read from any type. Check out our docs to learn more.

Default table format *

● Iceberg ○ Hive ○ Delta Lake

Validate the connection by hitting **Test connection.** Your catalog should return the same message indicating that you can now add the catalog. Confirm you see the **Hooray! You can now add this catalog to a cluster** message.



Test connection

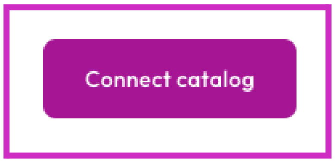
Validate that the network configuration allows Starburst Galaxy to connect to the data source.

Detected regions:

- aws US East (Ohio)

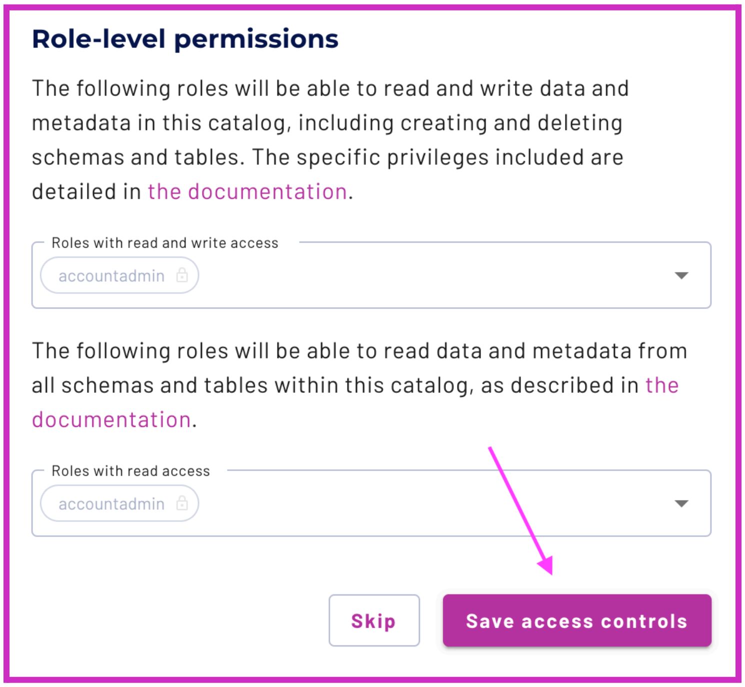
Hooray! You can now add this catalog to a cluster.

Select **Connect catalog**. This will save the credentials for your Amazon S3 catalog.



Step 3 - Set permissions

Next, accept the default permissions for your catalog by selecting the button **Save access controls**.



Role-level permissions

The following roles will be able to read and write data and metadata in this catalog, including creating and deleting schemas and tables. The specific privileges included are detailed in the documentation.

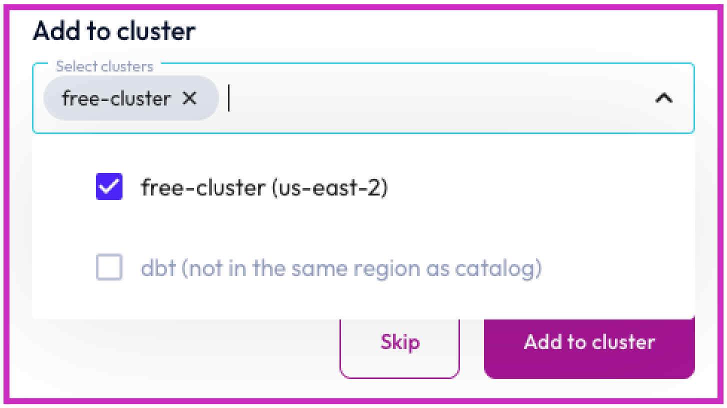
Roles with read and write access: accountadmin

The following roles will be able to read data and metadata from all schemas and tables within this catalog, as described in the documentation.

Roles with read access: accountadmin

Step 4 - Add to cluster

Select `free-cluster` in the **Select clusters** pulldown and then click on **Add to cluster**.



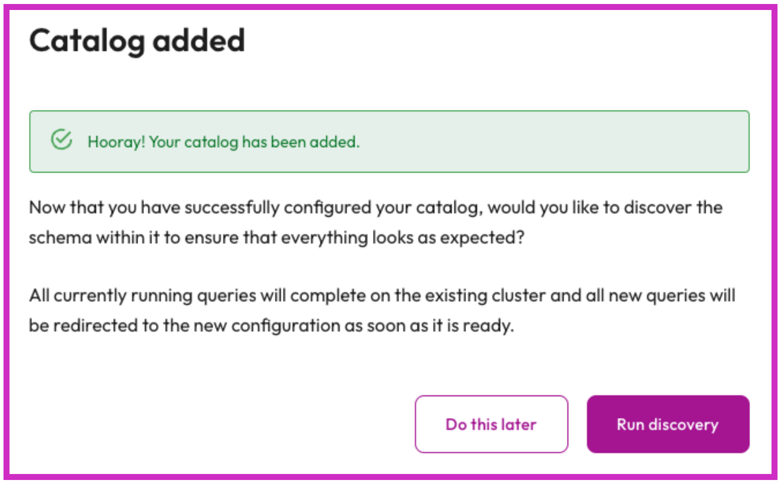
Add to cluster

Select clusters: free-cluster ✕

☑ free-cluster (us-east-2)

□ dbt (not in the same region as catalog)

Click **Do this later** in the **Catalog added** pop-up.



Catalog added

Hooray! Your catalog has been added.

Now that you have successfully configured your catalog, would you like to discover the schema within it to ensure that everything looks as expected?

All currently running queries will complete on the existing cluster and all new queries will be redirected to the new configuration as soon as it is ready.

Part 2: Create Snowflake catalog

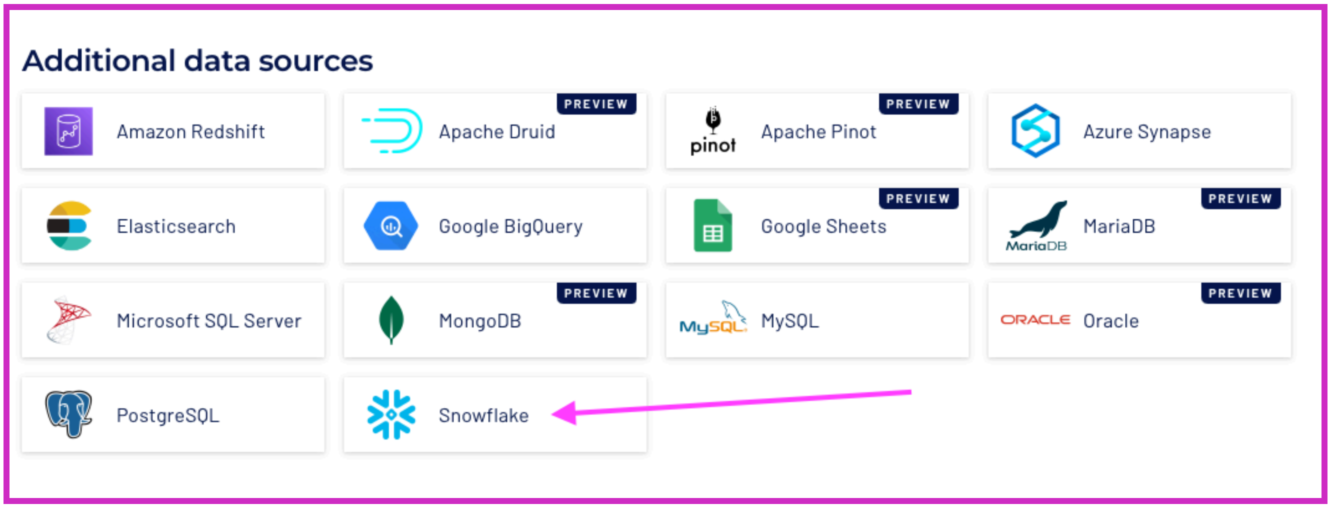
Objective

Now it's time to create a Snowflake catalog alongside your AWS S3 catalog. Later, this will allow us to federate across the two data sources.

Step 1 - Create Snowflake catalog

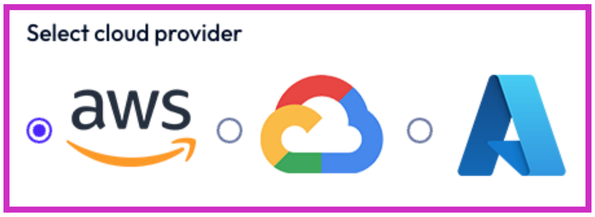
From the catalog page, select the **Create catalog** button to create the second catalog.

Choose **Snowflake**.



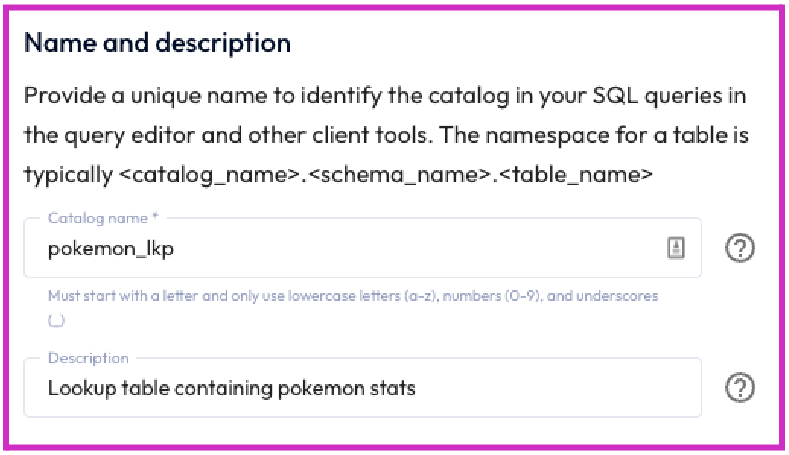
Using the list below as a guide, configure your catalog to query objects in Snowflake, specifically the Pokedex information. Provide the necessary credentials to authenticate the connection.

Cloud Provider: AWS


Select cloud provider

● aws ○ ○

Catalog Name: pokemon_lkp
Description: Lookup table containing pokemon stats


Name and description

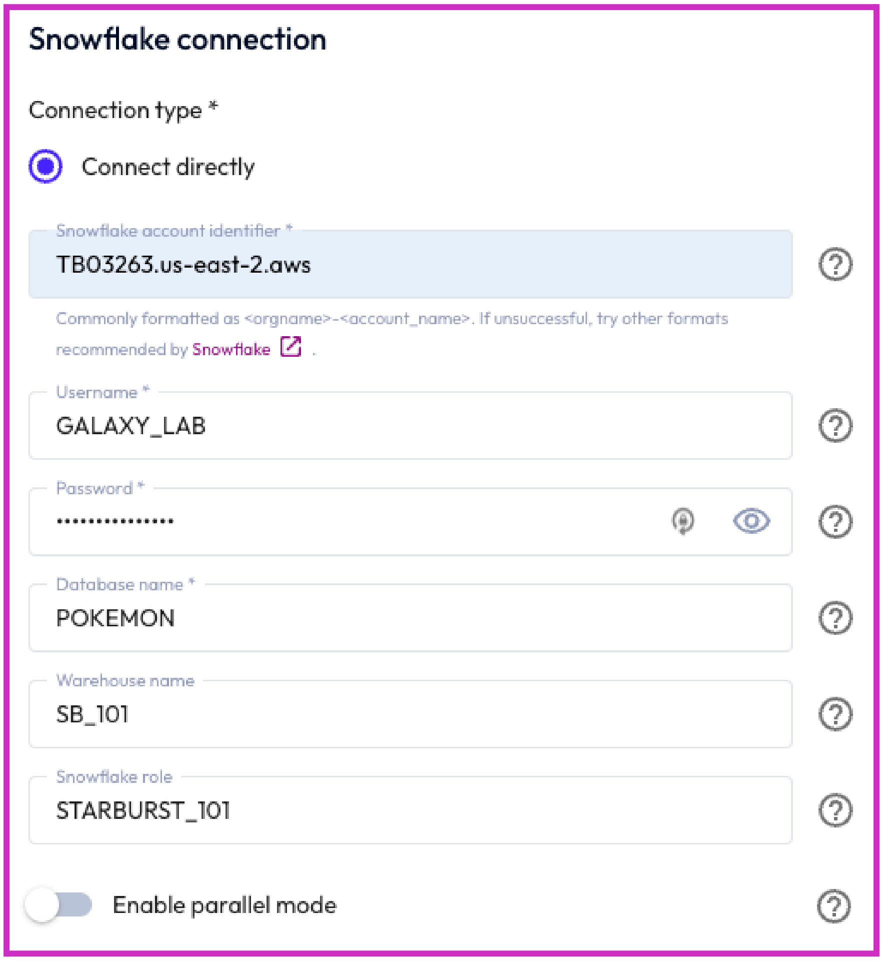
Provide a unique name to identify the catalog in your SQL queries in the query editor and other client tools. The namespace for a table is typically <catalog_name>.<schema_name>.<table_name>

Catalog name *: pokemon_lkp

Must start with a letter and only use lowercase letters (a-z), numbers (0-9), and underscores

Description: Lookup table containing pokemon stats

Snowflake account identifier: TB03263.us-east-2.aws
Username: SB_GALAXY
Password: **Bc912uR&2S$arT**
Database name: POKEMON
Warehouse name: SB_101
Snowflake role: STARBURST_101



Snowflake connection

Connection type *

● Connect directly

Snowflake account identifier *: TB03263.us-east-2.aws

Commonly formatted as <orgname>-<account_name>. If unsuccessful, try other formats recommended by Snowflake .

Username *: GALAXY_LAB

Password *: •••••••••••••••

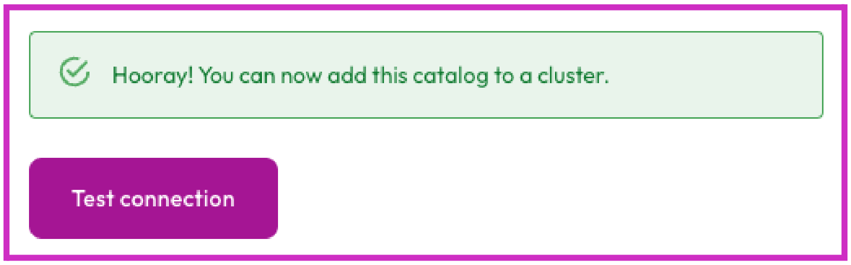
Database name *: POKEMON

Warehouse name: SB_101

Snowflake role: STARBURST_101

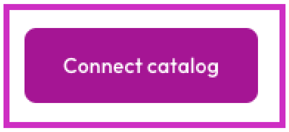
Enable parallel mode

Test the connection to ensure that the setup is correct.



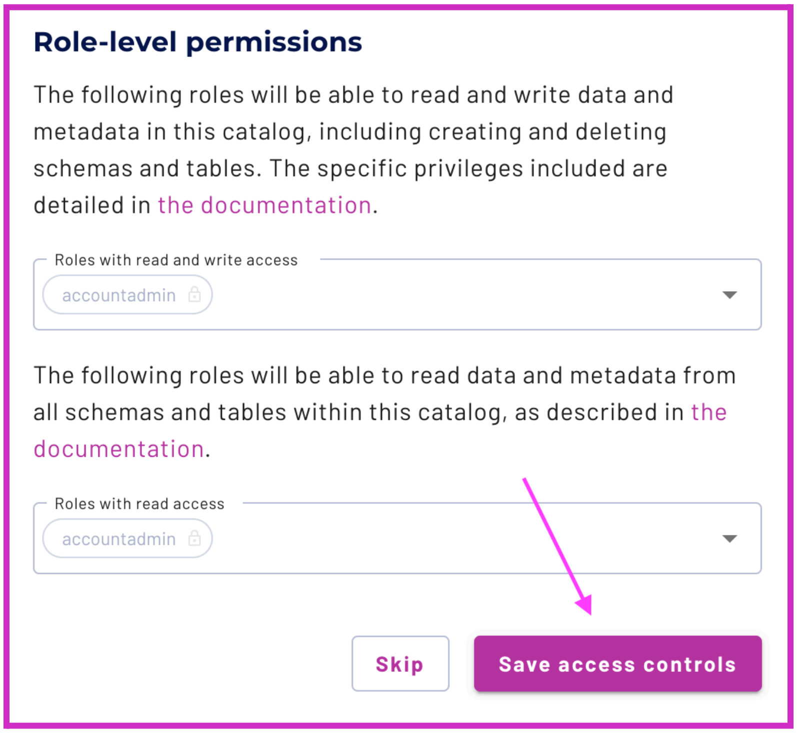
✓ Hooray! You can now add this catalog to a cluster.

Select **Connect catalog** to save the credentials for your Snowflake catalog.



Step 2 - Save access controls

Next, set the default permissions for your catalog by selecting the **Save access controls** button.



Role-level permissions

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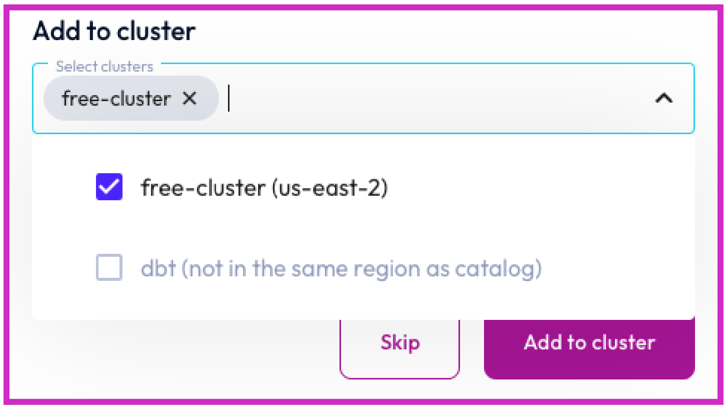
Roles with read and write access: accountadmin

The following roles will be able to read data and metadata from all schemas and tables within this catalog, as described in the documentation.

Roles with read access: accountadmin

Step 3 - Add to cluster

Select `free-cluster` in the **Select clusters** pulldown and then click on **Add to cluster**.



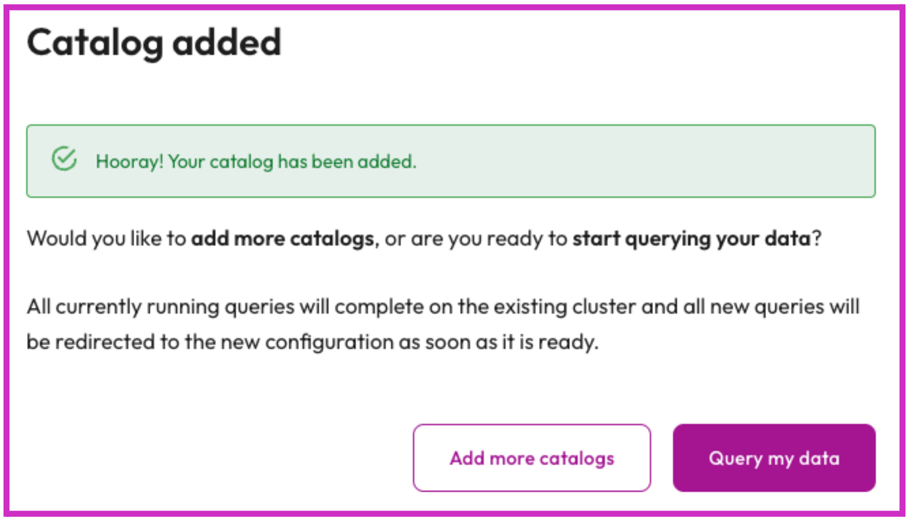
Add to cluster

Select clusters: free-cluster ✕

☑ free-cluster (us-east-2)

□ dbt (not in the same region as catalog)

Click **Query my data** in the **Catalog added** pop-up.



Catalog added

Hooray! Your catalog has been added.

Would you like to **add more catalogs**, or are you ready to **start querying your data**?

All currently running queries will complete on the existing cluster and all new queries will be redirected to the new configuration as soon as it is ready.

Lab 3: Build within your data lake

Learning objectives

- Demonstrate the process needed to run schema discovery to analyze a root object in an object storage location.
- Show how to use open table formats.
- Demonstrate the steps needed to build a reporting structure in your data lake, and secure your team's access.

Prerequisites

- Lab 1: Introduction and setup
- Lab 2: Connect to data sources

Activities

1. Use schema discovery
2. Discover the lookup data
3. Build the structure layer
4. Build the consume layer
5. Secure access to your consume layer

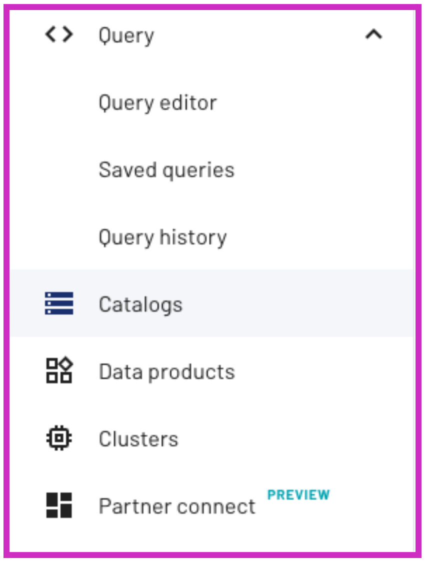
Part 1: Use schema discovery

Objective

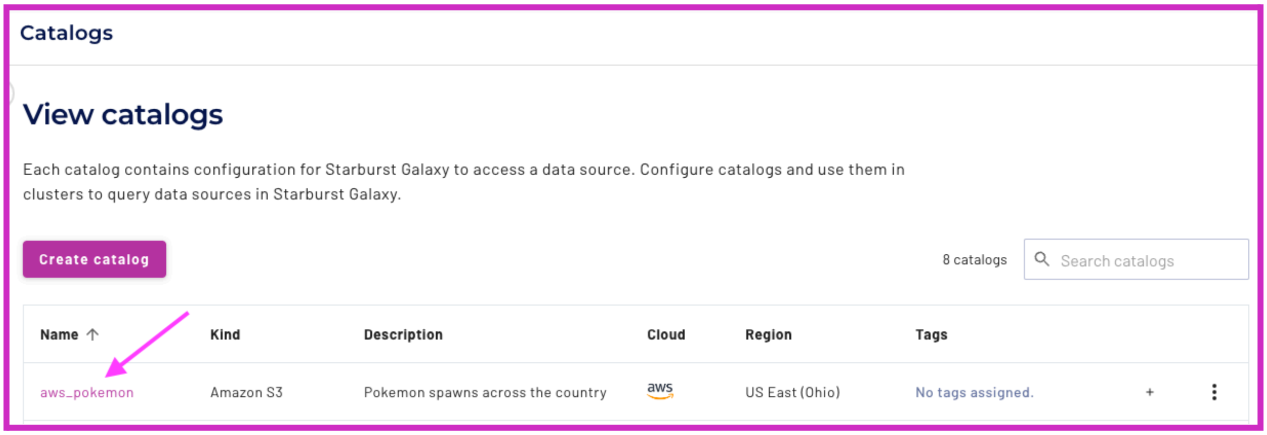
You're going to begin by utilizing schema discovery to create your schema and table. Schemas control the structure of the data inside them. Luckily for us, Starburst Gravity will take care of the discovery work.

Step 1 - Navigate to the catalogs page

In the left hand navigation pane, select **Catalogs**.



Select the **aws_pokemon** catalog to navigate within it.



Catalogs

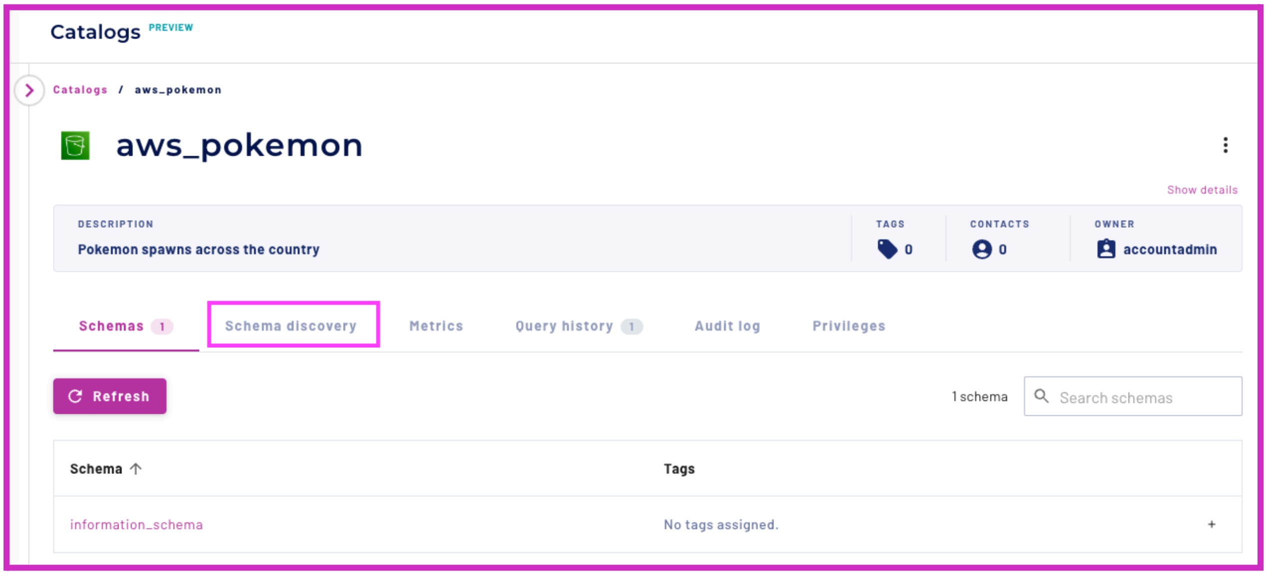
View catalogs

Each catalog contains configuration for Starburst Galaxy to access a data source. Configure catalogs and use them in clusters to query data sources in Starburst Galaxy.

Name ↑	Kind	Description	Cloud	Region	Tags
aws_pokemon	Amazon S3	Pokemon spawns across the country	aws	US East (Ohio)	No tags assigned.

Step 2 - Run Schema discovery

As part of Gravity, you can see all the metrics, schemas, query history, audit log, privileges, and more! Click on the **Schema discovery** tab.



Catalogs PREVIEW

Catalogs / aws_pokemon

aws_pokemon

DESCRIPTION: Pokemon spawns across the country

TAGS: 0

CONTACTS: 0

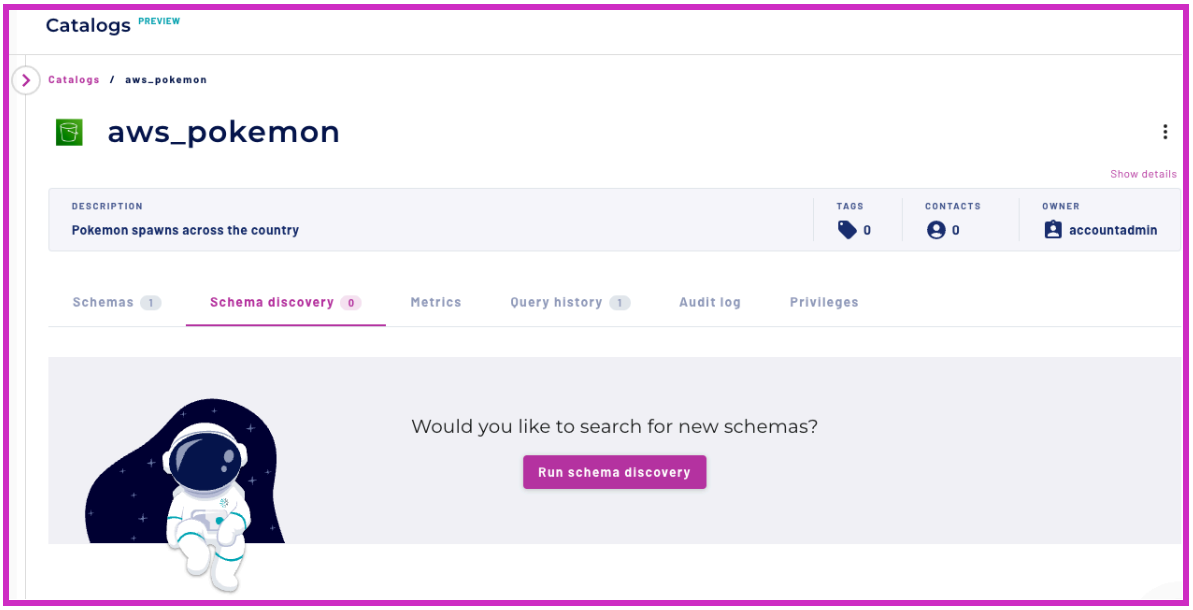
OWNER: accountadmin

Schema ↑	Tags
information_schema	No tags assigned.

The Schema discovery pane lets you examine the metadata of the specified object storage location. Schema discovery is for catalogs in object storage data sources only.

Use schema discovery to identify and register tables or views that are newly added to a known schema location. For example, a logging process might drop a new log file every hour, rolling over from the previous hour's log file. The purpose of schema discovery is to find the newly added files to make sure Starburst Galaxy knows how to query them.

Select **Run schema discovery**.

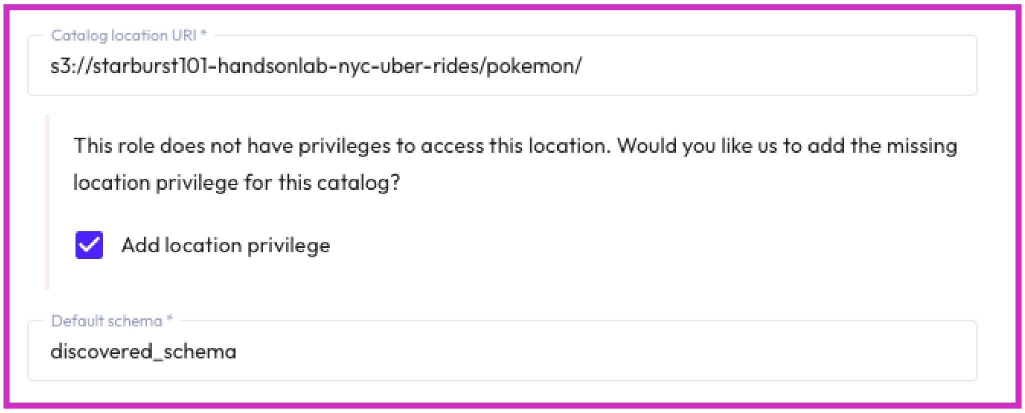


Add the following information:
Catalog location URL:

`s3://starburst101-handsonlab-nyc-uber-rides/pokemon/`

Add location privilege: Leave it checked

Default schema: `discovered_schema`



Catalog location URI *

s3://starburst101-handsonlab-nyc-uber-rides/pokemon/

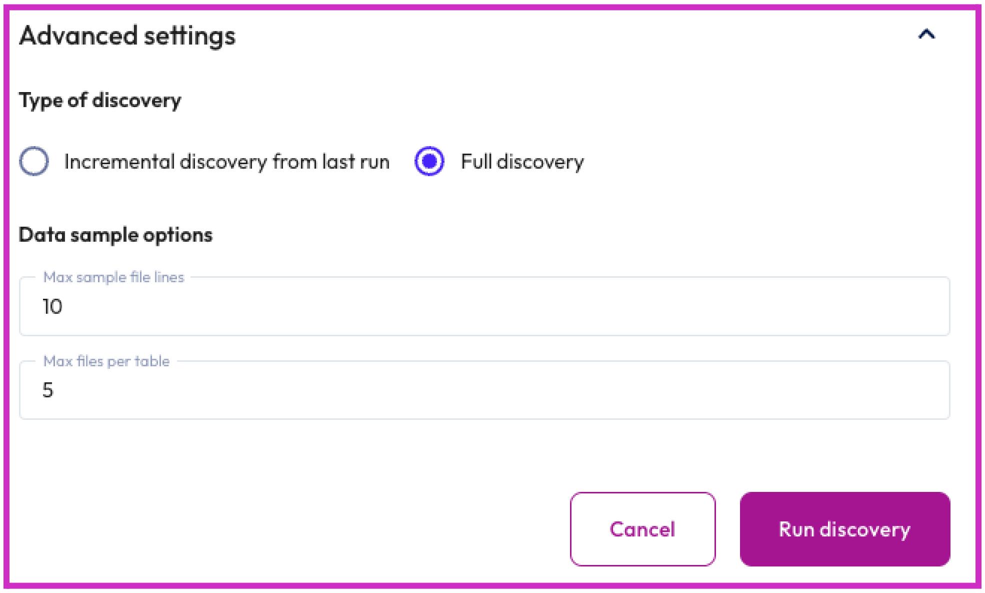
This role does not have privileges to access this location. Would you like us to add the missing location privilege for this catalog?

☑ Add location privilege

Default schema *

discovered_schema

Toggle the **Advanced settings** arrow down and select **Full discovery** for the **Type of discovery**.



Advanced settings

Type of discovery

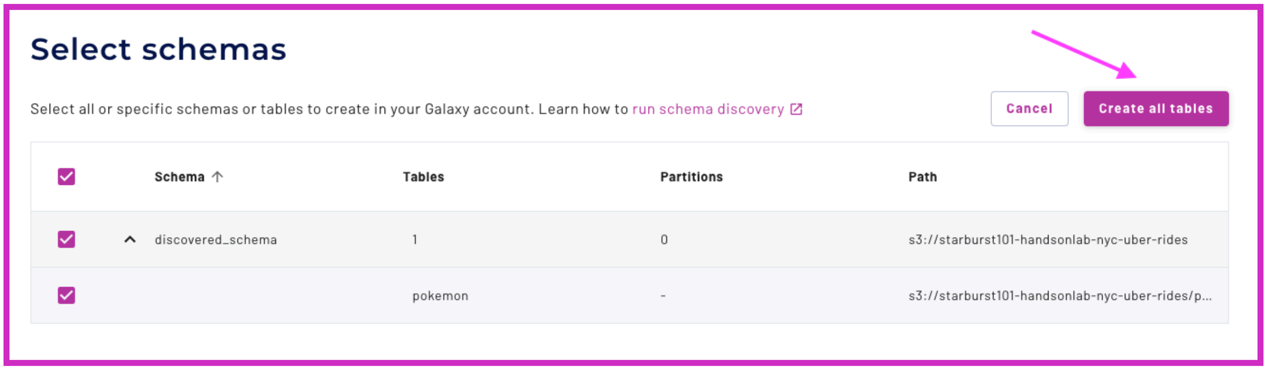
○ Incremental discovery from last run ● Full discovery

Data sample options

Max sample file lines: 10

Max files per table: 5

Click **Run discovery.** Starburst will start scanning for you. Then, it will return code to create your desired schema and table. Toggle open `discovered_schema` and then check the top checkbox to select the two below it. Select **Create all tables**.

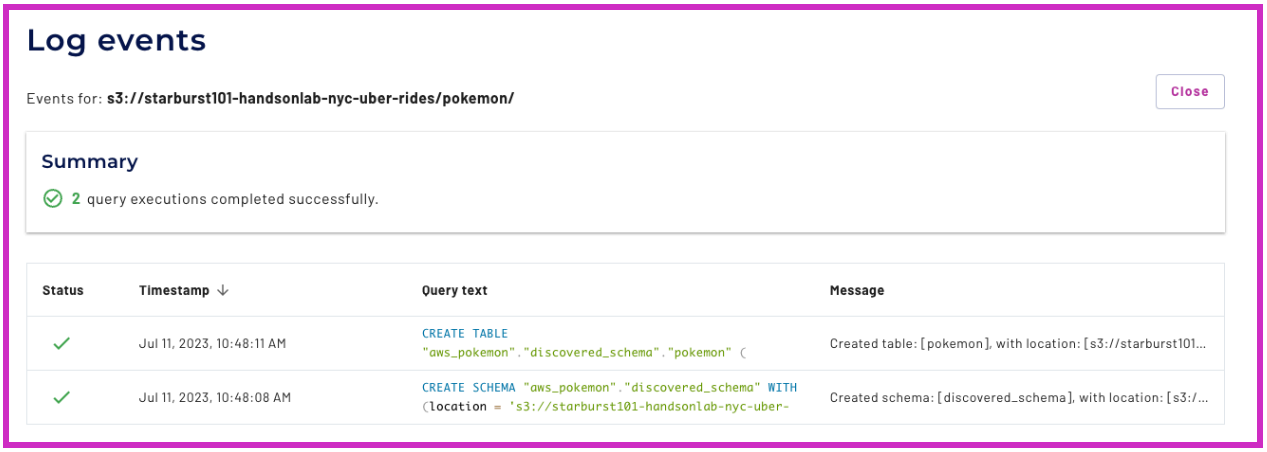


Select schemas

Select all or specific schemas or tables to create in your Galaxy account. Learn how to run schema discovery

☑	Schema ↑	Tables	Partitions	Path
☑	discovered_schema	1	0	s3://starburst101-handsonlab-nyc-uber-rides
☑		pokemon	-	s3://starburst101-handsonlab-nyc-uber-rides/p...

Schema discovery has done the heavy lifting so you don't have to spend time trying to investigate what columns exist, or bother your AWS administrator to give you details about the file.



Log events

Events for: **s3://starburst101-handsonlab-nyc-uber-rides/pokemon/**

Summary

✓ 2 query executions completed successfully.

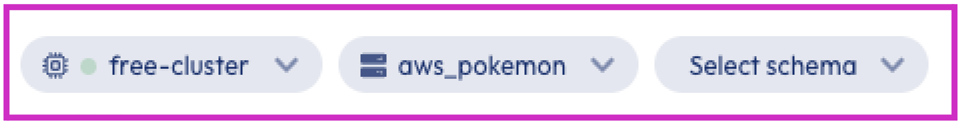
Status	Timestamp ↓	Query text	Message
✓	Jul 11, 2023, 10:48:11 AM	CREATE TABLE "aws_pokemon"."discovered_schema"."pokemon" (	Created table: [pokemon], with location: [s3://starburst101...
✓	Jul 11, 2023, 10:48:08 AM	CREATE SCHEMA "aws_pokemon"."discovered_schema" WITH (location = 's3://starburst101-handsonlab-nyc-uber-	Created schema: [discovered_schema], with location: [s3:/...

Click on the Query text to view the full queries. Your first query created the desired schema, and the second query created a Hive table. Hit **Close**.

Step 3 - Set up the Query editor

Navigate to the **Query editor**. If you already have queries, add a new tab + using the fuschia plus sign. Change the location drop-downs in the top left-hand corner to match the cluster and catalog previously created.

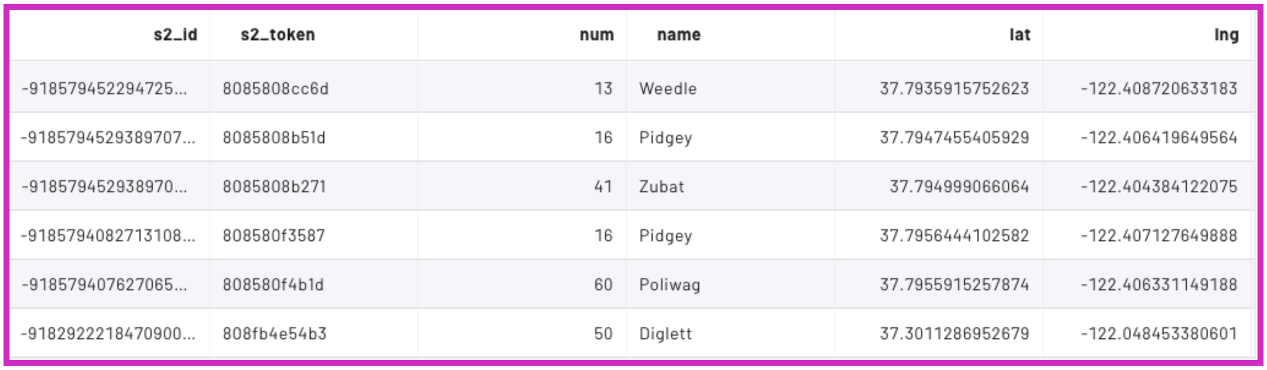
Cluster: free-cluster
Catalog: aws_pokemon



Run the following query to validate the table you created using schema discovery.

```
SELECT * from aws_pokemon.discovered_schema.pokemon LIMIT 100;
```

Your data sample should look something like the following:



s2_id	s2_token	num	name	lat	lng
-918579452294725...	8085808cc6d	13	Weedle	37.7935915752623	-122.408720633183
-9185794529389707...	8085808b51d	16	Pidgey	37.7947455405929	-122.406419649564
-918579452938970...	8085808b271	41	Zubat	37.794999066064	-122.404384122075
-9185794082713108...	808580f3587	16	Pidgey	37.7956444102582	-122.407127649888
-918579407627065...	808580f4b1d	60	Poliwag	37.7955915257874	-122.406331149188
-9182922218470900...	808fb4e54b3	50	Diglett	37.3011286952679	-122.048453380601

Run a command to view the CREATE TABLE statement:

```
SHOW CREATE TABLE discovered_schema.pokemon;
```

You should return the same code as run with Schema discovery. Notice that the columns are already utilizing proper data types. Also notice that the table format is HIVE. You will update this as you build your reporting structure in your data lake using Great Lakes connectivity.

Step 4 - Create your schema

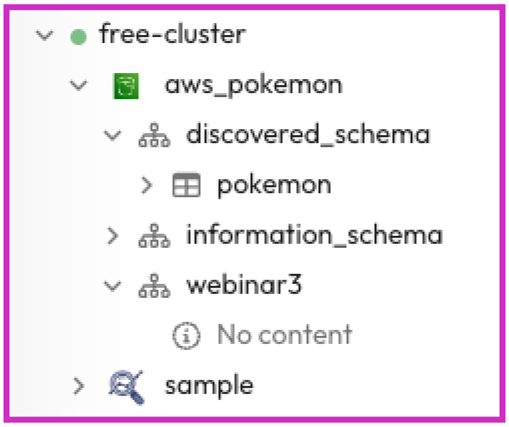
You have already created one schema, named `discovered_schema`. Now, create another schema so that you can separate out the table that was created from an external location and your own work.

Create a new schema by running the following command.

```
CREATE SCHEMA aws_pokemon.webinar3;
```

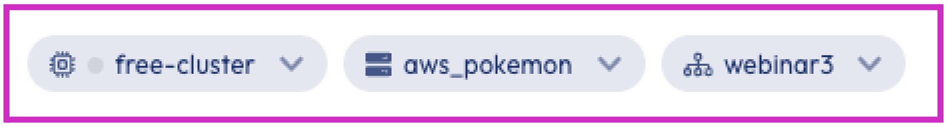
Step 5 - Verify schema in catalog

In the catalog explorer, close and expand the `aws_pokemon` catalog. In addition to the schema and table created earlier, `discovered_schema.pokemon`, verify your new `webinar3` schema is present. There will be other schemas listed.



Step 6 - Select schema after creation

Choose `webinar3` in the **Select schema** pulldown just above the editor.



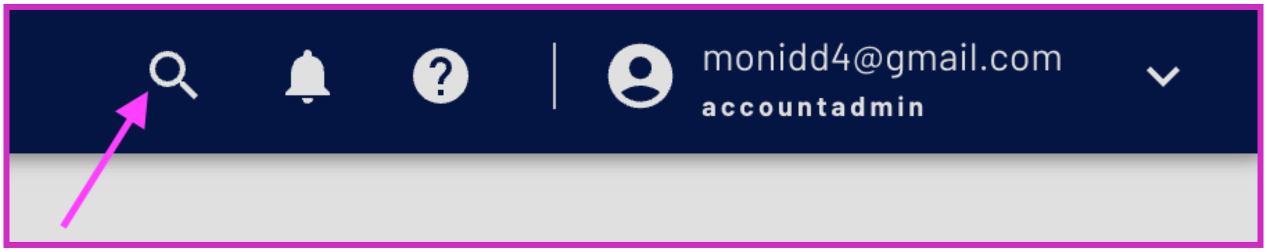
Part 2: Discover the Snowflake data source

Objective

Learn about the Pokedex lookup table stored in Snowflake using global search. Global search lets users find datasets quickly and intuitively. It is a powerful tool that helps keep better track of your data. Use global search to discover the Pokedex data in Snowflake and validate that connection.

Step 1 - Navigate Starburst UI

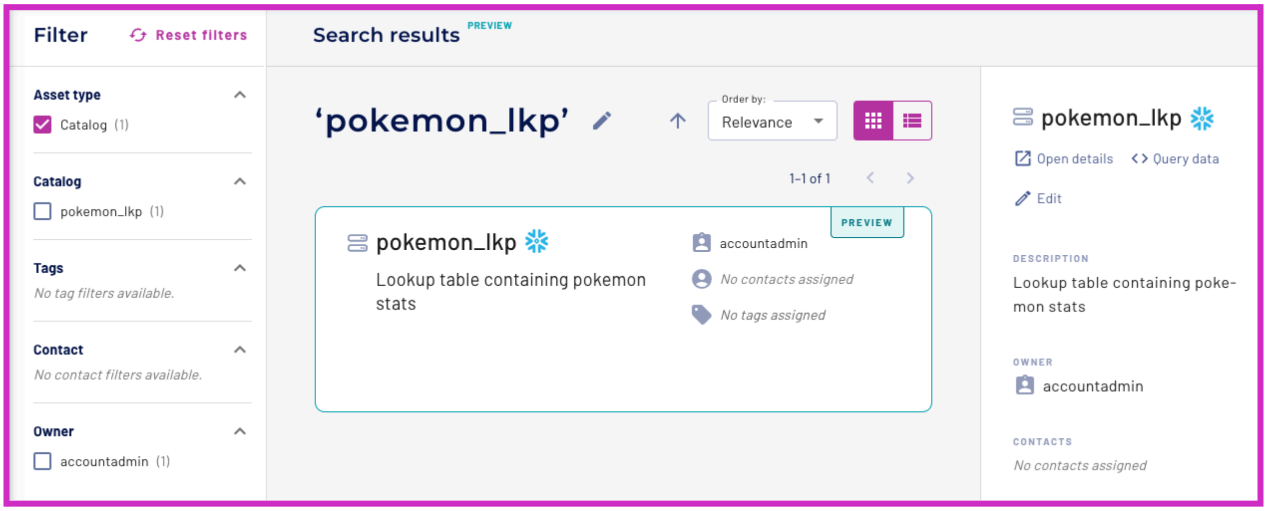
To use global search, select the magnifying glass icon in the upper-right corner.



Step 2 - Execute global search

Enter `pokemon_lkp` and select **View all results** at the bottom of the pop-up window.

Starburst Galaxy lets you filter and organize your search results. This is handy when you have a bigger environment with more results.



No tag filters available.

No contact filters available.

Lookup table containing pokemon stats

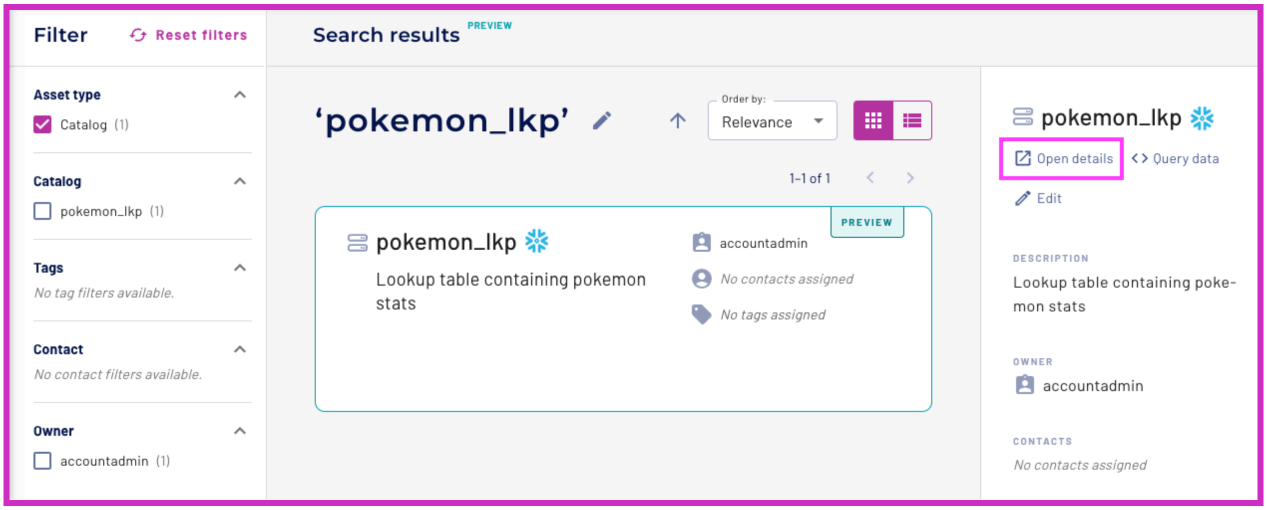
No contacts assigned

No tags assigned

Lookup table containing pokemon stats

No contacts assigned

Click on the **Open details** in the top right corner.



Filter　Reset filters

Search results PREVIEW

Asset type
☑ Catalog (1)

Catalog
□ pokemon_lkp (1)

Tags
No tag filters available.

Contact
No contact filters available.

Owner
□ accountadmin (1)

'pokemon_lkp'

Order by: Relevance

1-1 of 1

PREVIEW
pokemon_lkp
Lookup table containing pokemon stats
accountadmin
No contacts assigned
No tags assigned

pokemon_lkp
Open details　<> Query data
Edit

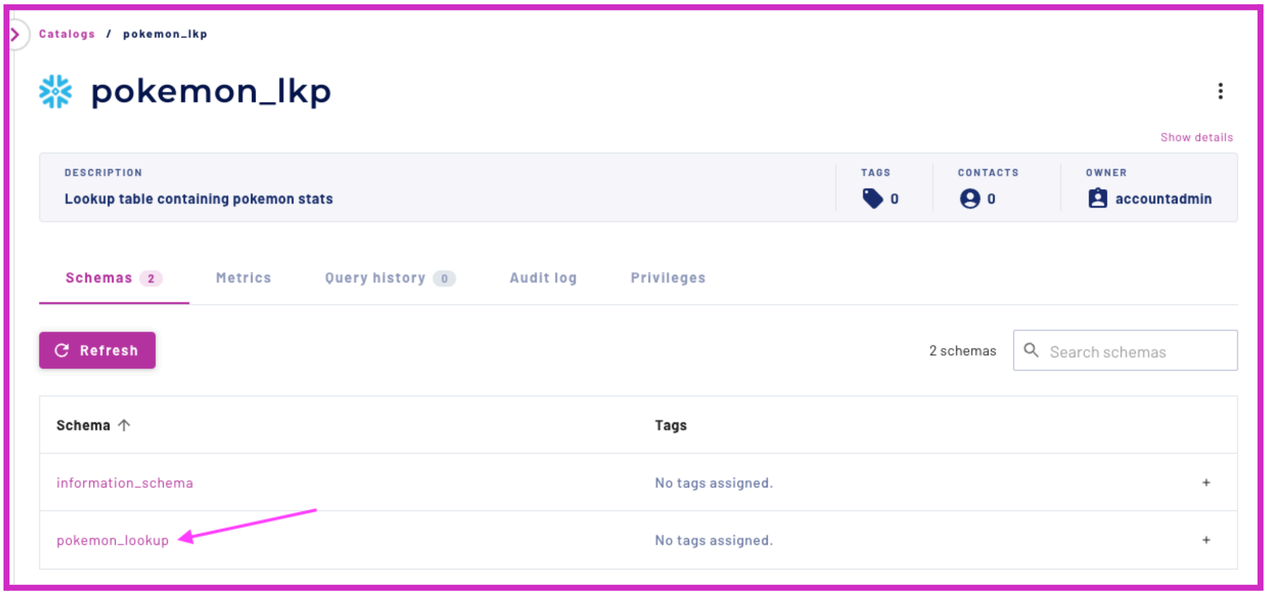
DESCRIPTION
Lookup table containing pokemon stats

OWNER
accountadmin

CONTACTS
No contacts assigned

Step 3 - Explore your Snowflake data source

Notice that Starburst Galaxy automatically places you within the catalog page. You can see the catalog has a place to add additional details, as well as shared information regarding **Schemas**, **Metrics**, **Query history**, **Audit log**, and **Privileges.** Click within the `pokemon_lookup` schema to learn more.



Catalogs / pokemon_lkp

pokemon_lkp

Show details

DESCRIPTION	TAGS	CONTACTS	OWNER
Lookup table containing pokemon stats	0	0	accountadmin

Schemas 2　Metrics　Query history 0　Audit log　Privileges

Refresh　2 schemas　Search schemas

Schema	Tags
information_schema	No tags assigned.
pokemon_lookup	No tags assigned.

Within the schema, you can see more information available to you. Stay tuned throughout the lab as you will come back and utilize these features of Starburst Gravity. For now, click within the `pokedex` table.

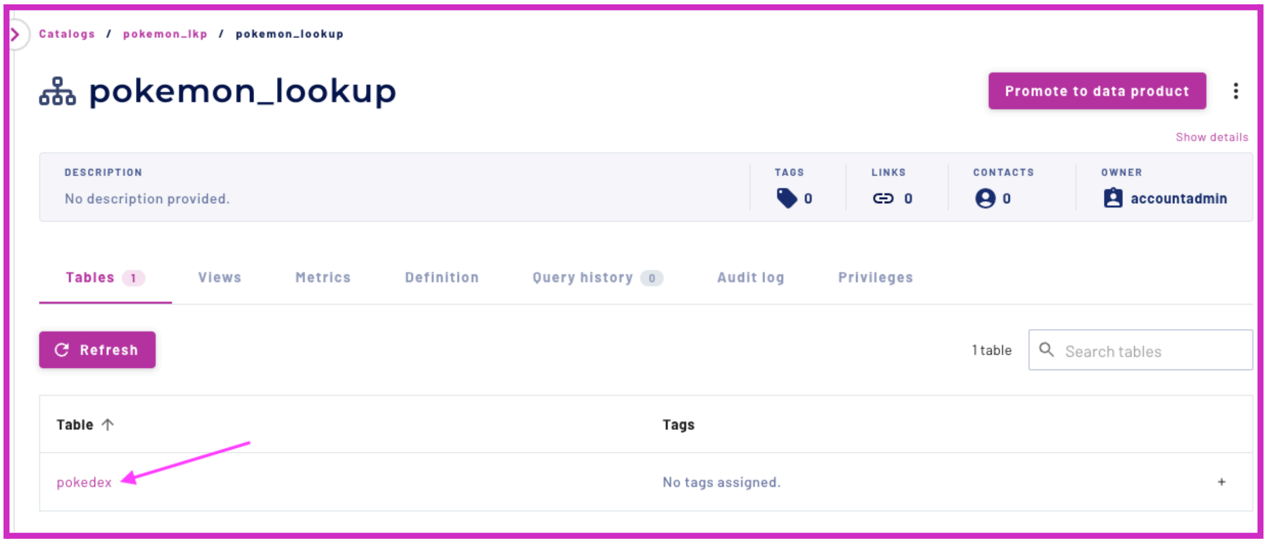
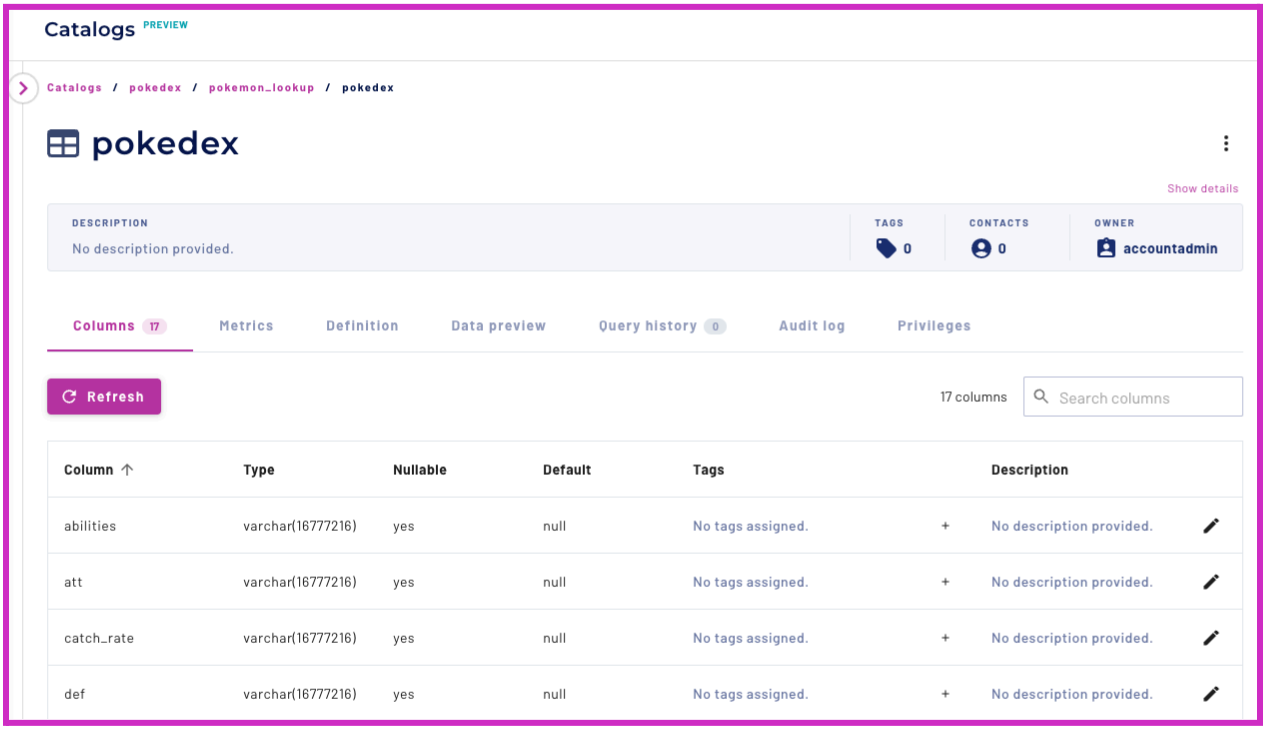


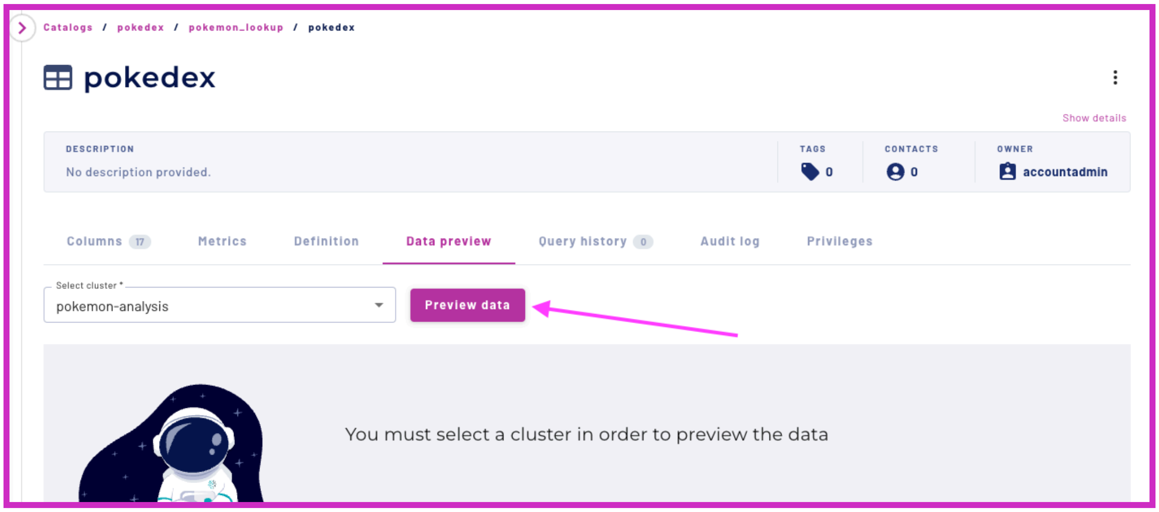
Table ↑	Tags
pokedex	No tags assigned.

You can see a preview of the **Columns** in the table. You also see all the **Metrics**, the **Definition**, the **Data preview**, the **Query history**, the **Audit log**, and the **Privileges**.



Column ↑	Type	Nullable	Default	Tags	Description
abilities	varchar(16777216)	yes	null	No tags assigned.	No description provided.
att	varchar(16777216)	yes	null	No tags assigned.	No description provided.
catch_rate	varchar(16777216)	yes	null	No tags assigned.	No description provided.
def	varchar(16777216)	yes	null	No tags assigned.	No description provided.

Navigate to the **Data preview** tab. Make sure the `free-cluster` cluster is selected, then hit **Preview data**.



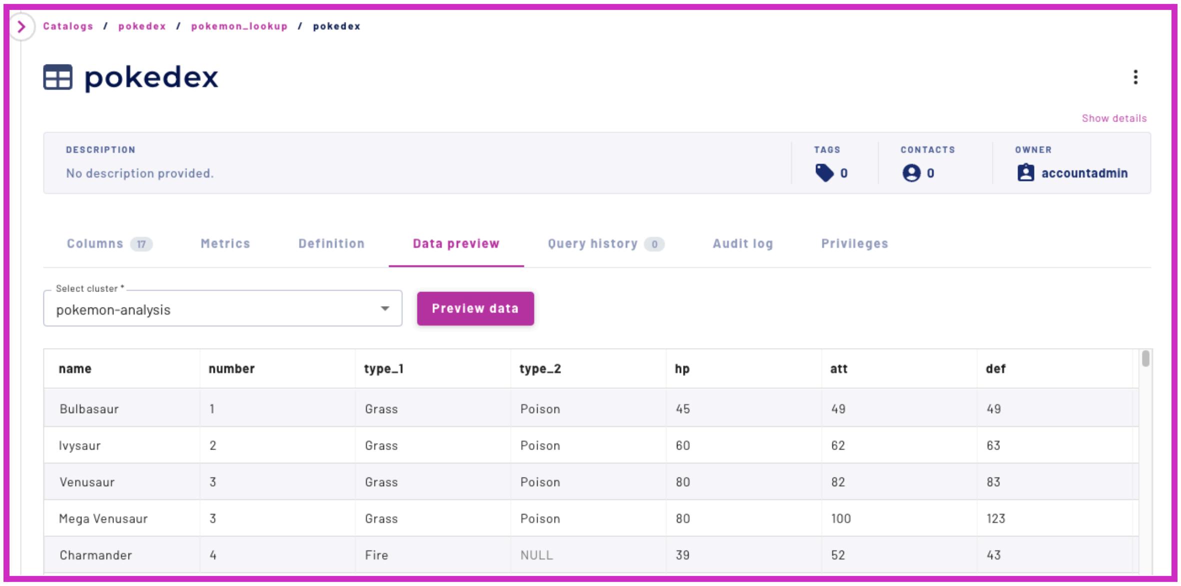
DESCRIPTION: No description provided.

TAGS: 0 CONTACTS: 0 OWNER: accountadmin

Select cluster *: pokemon-analysis

You must select a cluster in order to preview the data

The data is available to be previewed without ever having to run a query. This is handy if you have any data consumers who want access to the data but do not want to use the **Query editor**.



DESCRIPTION: No description provided.

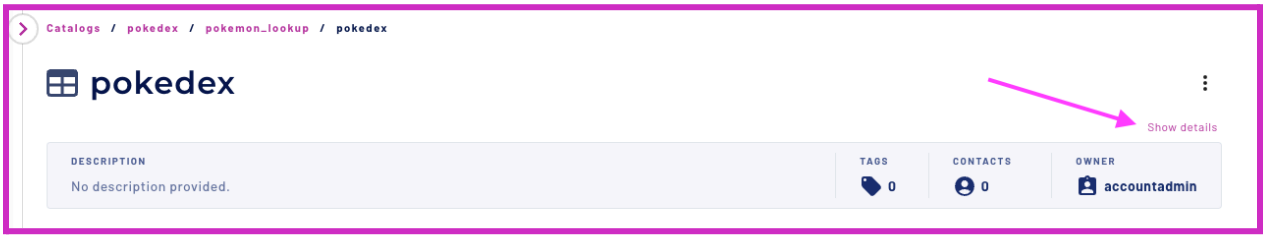
TAGS: 0 CONTACTS: 0 OWNER: accountadmin

Select cluster *: pokemon-analysis

name	number	type_1	type_2	hp	att	def
Bulbasaur	1	Grass	Poison	45	49	49
Ivysaur	2	Grass	Poison	60	62	63
Venusaur	3	Grass	Poison	80	82	83
Mega Venusaur	3	Grass	Poison	80	100	123
Charmander	4	Fire	NULL	39	52	43

Step 4 - Enter in data definitions

Add the following information to your table so that anyone else who looks at the table has some basic understanding of the data. Hit **Show details**.



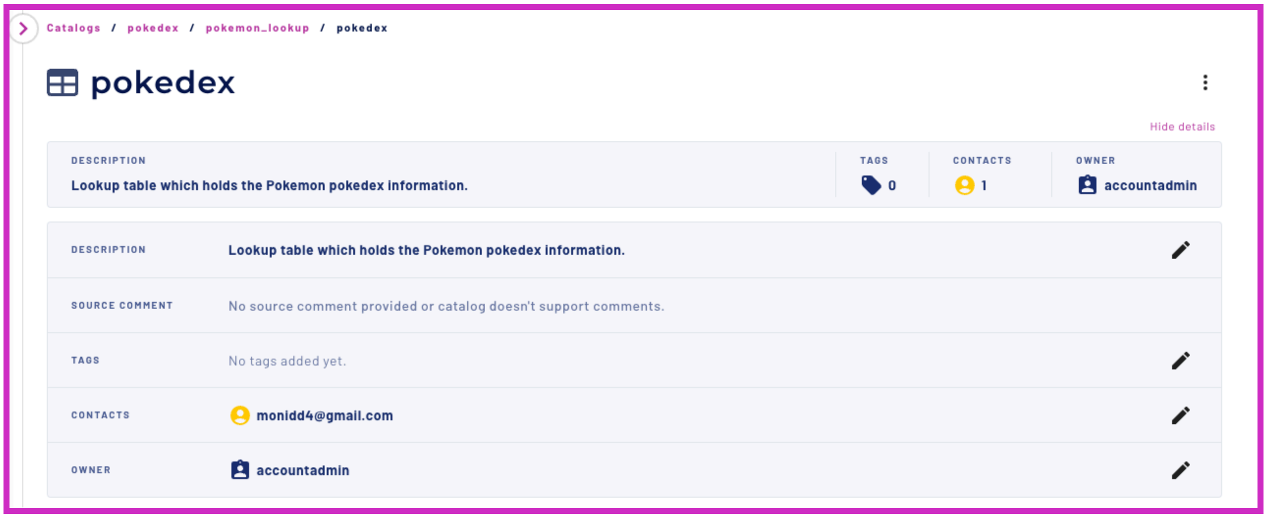
Catalogs / pokedex / pokemon_lookup / pokedex

pokedex

DESCRIPTION	TAGS	CONTACTS	OWNER
No description provided.	0	0	accountadmin

Click on the pencil icon on the right of the 2 entries below to enter the information provided below:

Description: Lookup table which holds the Pokemon pokedex information.
Contacts: yourself



Catalogs / pokedex / pokemon_lookup / pokedex

pokedex

DESCRIPTION	TAGS	CONTACTS	OWNER
Lookup table which holds the Pokemon pokedex information.	0	1	accountadmin

DESCRIPTION	Lookup table which holds the Pokemon pokedex information.
SOURCE COMMENT	No source comment provided or catalog doesn't support comments.
TAGS	No tags added yet.
CONTACTS	monidd4@gmail.com
OWNER	accountadmin

Now those reading the dataset for the first time will have more context.

Part 3: Build your reporting structure in S3

Objective

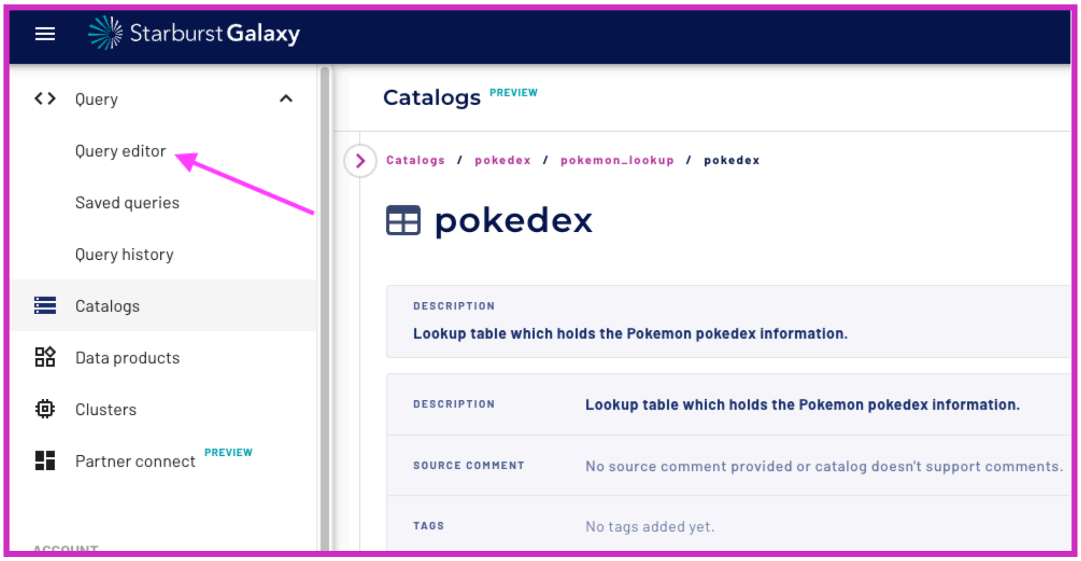
Now it's time to use both your data sources and create a reporting structure in S3.

- **Land layer** - This is the raw data you were ingesting that's landing in S3. Thanks to schema discovery, this layer is already created.
- **Structure layer** - This is the enriched, cleaned, and cleansed data.
- **Consume layer** - This is the data that is ready to be queried and utilized by consumers.

Starburst is special because it allows you to build this reporting structure not just with data that already exists in your data lake, but also with data that exists in other data sources in your orbit - like our Snowflake pokedex data.

Step 1 - Set up the query editor

Using the left-hand pane, navigate back to the **Query editor**.

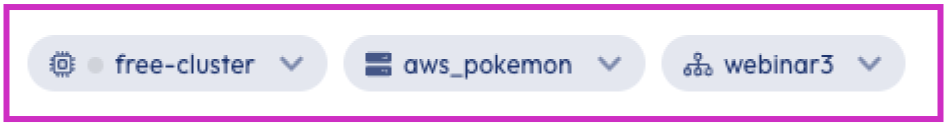


pokedex

DESCRIPTION
Lookup table which holds the Pokemon pokedex information.

DESCRIPTION	Lookup table which holds the Pokemon pokedex information.
SOURCE COMMENT	No source comment provided or catalog doesn't support comments.
TAGS	No tags added yet.

Make sure you are in the tab you previously created, or use a new tab that has the cluster, catalog, and schema selected like below.



free-cluster | aws_pokemon | webinar3

Step 2 - Create the pokemon_spawns structure table

Recall that the default table format you set for this catalog was Iceberg. However, you are still able to create a table with the Hive table format due to Great Lakes connectivity in Starburst Galaxy. Great Lakes connectivity abstracts the details of using different table formats and file types when using certain write access statements for object storage systems.

Part of your cleansing in the structure layer is to update the table format from Hive to Iceberg and convert the text file to an ORC file. The table you just created with schema discovery is not yet fully optimized and transformed.

To fix this, you must build a structure layer by creating a new table and casting the necessary values into more accurate data types. To help with this, you will also create the table using the ORC file format. This improves performance when using the Iceberg table format.

Run the following command to create the structure layer table.

```
CREATE TABLE pokemon_spawns_structure
(
      number INTEGER,
      name VARCHAR,
      latitude DOUBLE,
      longitude DOUBLE,
      encounter_seconds BIGINT
)
WITH (
      format = 'ORC',
      type = 'ICEBERG'
);
```

Step 3 - Insert data into the pokemon_spawns structure table

Once the table is created, you need to insert the data into it.

Note: After doing this manually the first time, you can automate the process in the future using an orchestration tool like Airflow, Prefect, or Dagster.

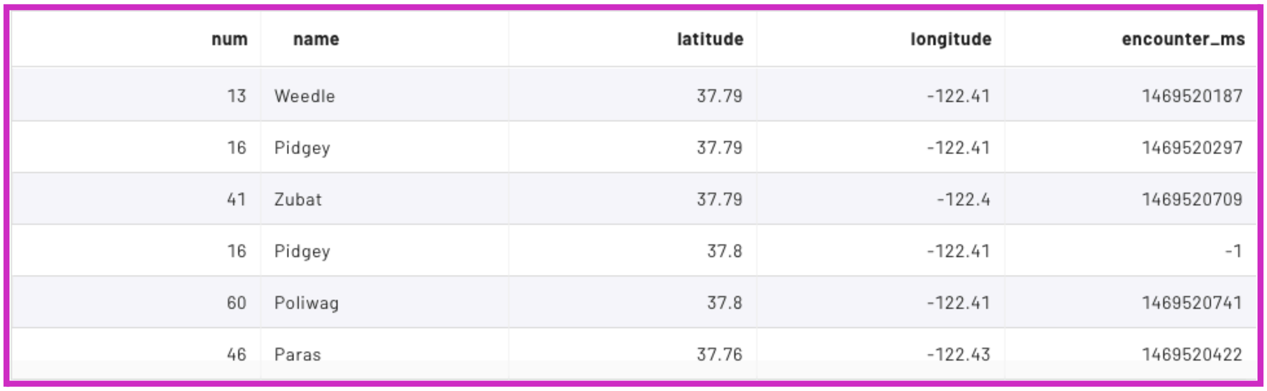
```
INSERT INTO
      pokemon_spawns_structure
SELECT
      CAST(num AS INTEGER) AS number,
      name,
      round(lat, 2) AS latitude,
      round(lng, 2) AS longitude,
      CASE
            WHEN encounter_ms = -1 THEN encounter_ms
            ELSE (encounter_ms / 1000)
      END AS encounter_seconds
FROM aws_pokemon.discovered_schema.pokemon
WHERE lat >= 37.62 and lat <= 37.86
  AND lng >= -122.51 and lng <= -122.12;
```

You should insert 95197 rows.

Step 4 - Validate the pokemon_spawns_structure table

It is considered best practice to validate that the new table has been created. To do this, run a simple select statement.

```
SELECT * FROM pokemon_spawns_structure LIMIT 10;
```



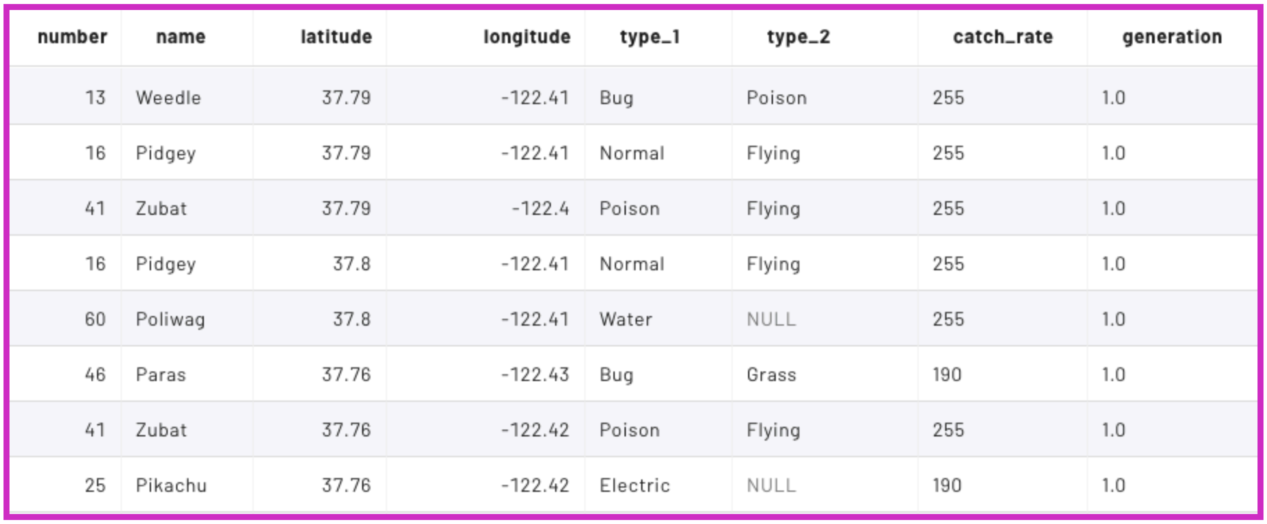
num	name	latitude	longitude	encounter_ms
13	Weedle	37.79	-122.41	1469520187
16	Pidgey	37.79	-122.41	1469520297
41	Zubat	37.79	-122.4	1469520709
16	Pidgey	37.8	-122.41	-1
60	Poliwag	37.8	-122.41	1469520741
46	Paras	37.76	-122.43	1469520422

Step 5 - Preview the lookup table

The data in the lookup table also needs to be cleaned and optimized. It's best practice to clean up the data in the structure layer before creating the consume layer. First, run a quick join to show the federation capabilities available within Starburst Galaxy and join the newly created S3 `pokemon_spawns_structure` table with the unoptimized Snowflake lookup table `pokemon_lkp`.

Run the following command:

```
SELECT
     S.number,
     S.name,
     S.latitude,
     S.longitude,
     P.type_1,
     P.type_2,
     P.catch_rate,
     p.generation
FROM pokemon_lkp.pokemon_lookup.pokedex p
JOIN pokemon_spawns_structure s
  ON CAST(p.number AS INTEGER) = s.number;
```



number	name	latitude	longitude	type_1	type_2	catch_rate	generation
13	Weedle	37.79	-122.41	Bug	Poison	255	1.0
16	Pidgey	37.79	-122.41	Normal	Flying	255	1.0
41	Zubat	37.79	-122.4	Poison	Flying	255	1.0
16	Pidgey	37.8	-122.41	Normal	Flying	255	1.0
60	Poliwag	37.8	-122.41	Water	NULL	255	1.0
46	Paras	37.76	-122.43	Bug	Grass	190	1.0
41	Zubat	37.76	-122.42	Poison	Flying	255	1.0
25	Pikachu	37.76	-122.42	Electric	NULL	190	1.0

You can see that data from two different data sources (catalogs) are returned with one federated query. This is beneficial when performing interactive analytics; specifically for data consumers who could not otherwise get this information without a data engineer.

Step 6 - Create a pokedex structure table

Now, create a table which will store an optimized version of this table. Create this table as a delta lake table. Why would you create a Delta Lake table? Because Starburst Galaxy's Great Lakes connectivity gives you the ability to query multiple table formats at once. You will test this out later in the lab. Run the following command:

```
CREATE TABLE pokemon_pokedex_structure
(
      name VARCHAR,
      number INTEGER,
      type_1 VARCHAR,
      type_2 VARCHAR,
      catch_rate INTEGER,
      final_evolution DOUBLE,
      generation DOUBLE,
      abilities DOUBLE
)
WITH (
      type = 'DELTA'
);
```

Step 7 - Insert data into the pokemon_pokedex structure table

Once the table is created, you need to insert the data into it. Run the following command.

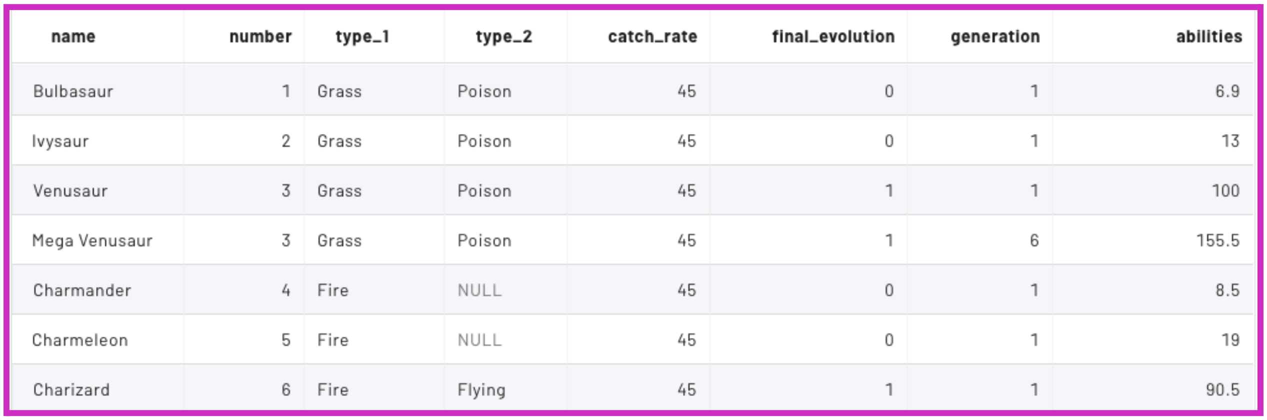
```
INSERT INTO pokemon_pokedex_structure
SELECT
      name,
      CAST(number AS INTEGER) as number,
      type_1,
      type_2,
      CAST(catch_rate AS INTEGER) as catch_rate,
      CAST(final_evolution AS DOUBLE) as final_evolution,
      CAST(generation AS DOUBLE) as generation,
      CAST(abilities AS DOUBLE) as abilities
FROM pokemon_lkp.pokemon_lookup.pokedex;
```

You should insert 1032 rows.

Step 8 - Validate the pokemon_pokedex_structure table

It is considered best practice to validate that the new table has been created. To do this, run a simple select statement.

```
SELECT * FROM pokemon_pokedex_structure LIMIT 10;
```



name	number	type_1	type_2	catch_rate	final_evolution	generation	abilities
Bulbasaur	1	Grass	Poison	45	0	1	6.9
Ivysaur	2	Grass	Poison	45	0	1	13
Venusaur	3	Grass	Poison	45	1	1	100
Mega Venusaur	3	Grass	Poison	45	1	6	155.5
Charmander	4	Fire	NULL	45	0	1	8.5
Charmeleon	5	Fire	NULL	45	0	1	19
Charizard	6	Fire	Flying	45	1	1	90.5

Part 4: Build the consume layer

Objective

Now it’s time to construct the last of the three layers of your data lake reporting structure, the consume layer. This will ready the layer for final consumption by data consumers.

Step 1 - Revisit the business requirements

Take this opportunity to refamiliarize yourself with the business case. This will inform the kinds of questions that you will ask about your dataset.

In this scenario, the business case required you to:

1. Create a final table output combining data from both structure tables.
2. Create a data product answering two specific business questions from the marketing department.
    c. What are the easiest and most popular Pokemon to catch in San Francisco by Type_1?
    d. Find the total number of Pokemon caught for each Type_1 and Type_2 pairing. Also, find the average catch rate.

Note: Easiest is defined by having a high catch rate. A high catch rate is greater than or equal to 100. Also consider that in the structure layer, you filtered out data that did not exist in the San Francisco Bay Area.

Step 2 - Create the consume table

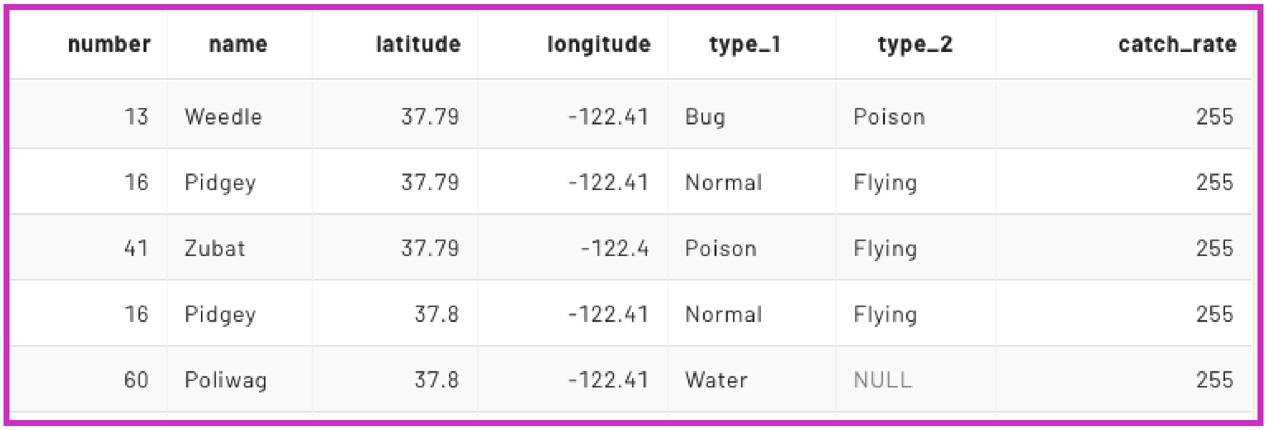
Run the following query to create the consume table. This constructs a new table from two separate tables in S3. Note that the `pokemon_spawns_structure` table is an Iceberg table and the `pokemon_pokedex_structure` table is a Delta Lake table.

```
CREATE TABLE pokemon_final_spawns AS
SELECT
      s.number,
      s.name,
      s.latitude,
      s.longitude,
      p.type_1,
      p.type_2,
      p.catch_rate
FROM pokemon_pokedex_structure p
JOIN pokemon_spawns_structure s ON p.number = s.number
WHERE catch_rate > 100;
```

The results should show 94626 rows were added.

Run a `SELECT` statement to validate that the table's values are similar to the image below.

```
SELECT * FROM pokemon_final_spawns LIMIT 10;
```



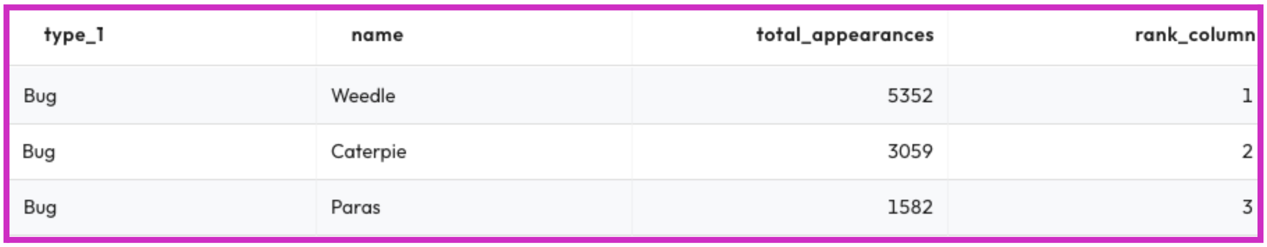
number	name	latitude	longitude	type_1	type_2	catch_rate
13	Weedle	37.79	-122.41	Bug	Poison	255
16	Pidgey	37.79	-122.41	Normal	Flying	255
41	Zubat	37.79	-122.4	Poison	Flying	255
16	Pidgey	37.8	-122.41	Normal	Flying	255
60	Poliwag	37.8	-122.41	Water	NULL	255

Step 3 - Find the easiest and most popular Pokemon in San Francisco

Now, you need to derive two different views for the marketing department. These will be used to answer the business questions. Remember, easiest is defined by a catch rate of greater than or equal to 100. The most popular is defined as the most number of appearances for a certain Pokemon for each Type_1.

Create a window function to rank the most popular Pokemon for each Type_1.

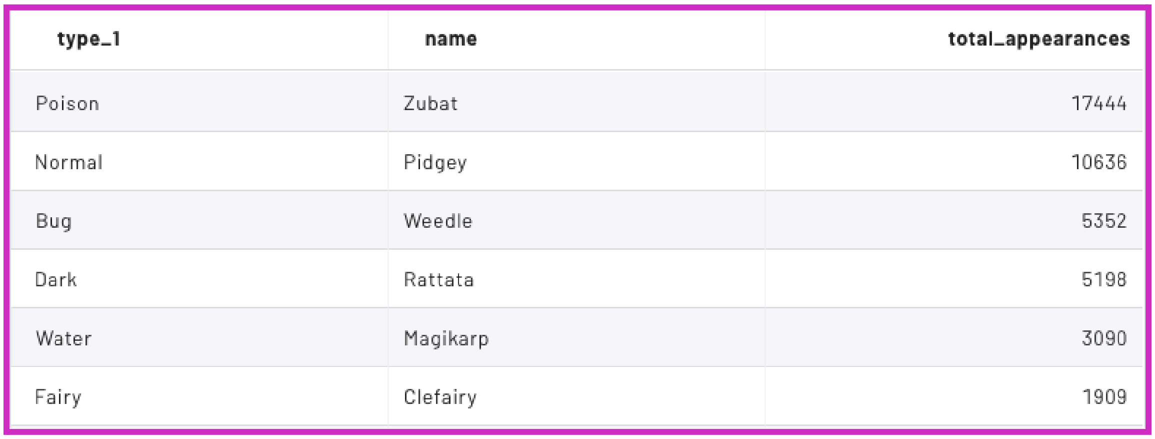
```
SELECT
      type_1,
      name,
      COUNT(*) AS total_appearances,
      RANK() OVER (PARTITION BY type_1 ORDER BY count(name) DESC
      ) AS rank_column
FROM
      pokemon_final_spawns
GROUP BY
      type_1,
      name
ORDER BY
      type_1,
      COUNT(*) DESC;
```



type_1	name	total_appearances	rank_column
Bug	Weedle	5352	1
Bug	Caterpie	3059	2
Bug	Paras	1582	3

Next, utilize a WITH statement to run a subquery and only select the most popular Pokemon types.

```
WITH
popular_types AS (
   SELECT
      type_1,
      name,
      COUNT(*) AS total_appearances,
      RANK() OVER (PARTITION BY type_1 ORDER BY COUNT(name) DESC
      ) AS rank_column
   FROM
      pokemon_final_spawns
   GROUP BY
      type_1,
      name
   ORDER BY
      type_1,
      COUNT(*) DESC
)
SELECT
   type_1,
   name,
   total_appearances
FROM
   popular_types
WHERE
   rank_column = 1
ORDER BY
   total_appearances DESC;
```



type_1	name	total_appearances
Poison	Zubat	17444
Normal	Pidgey	10636
Bug	Weedle	5352
Dark	Rattata	5198
Water	Magikarp	3090
Fairy	Clefairy	1909

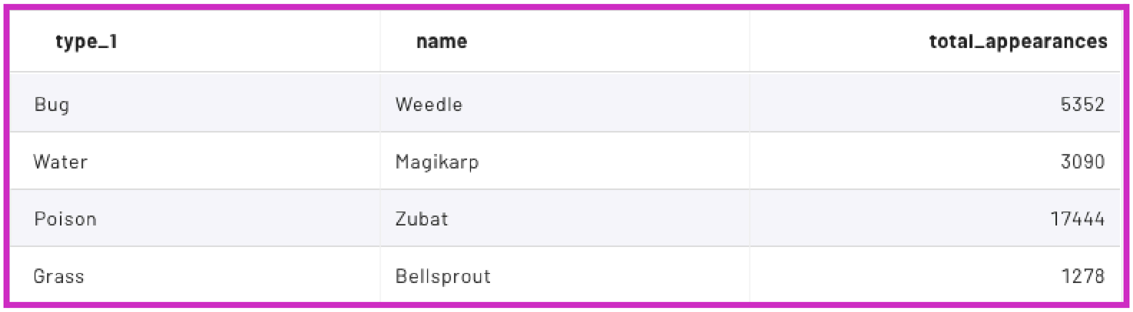
Step 4 - Create the first marketing view

Finally, you need to create a view to make the data visible to the marketing team. Use the SQL statement below. It is the same as the last step, but with the first line added to it.

```
CREATE OR REPLACE VIEW popular_types_sf_vw AS
WITH
popular_types AS (
   SELECT
      type_1,
      name,
      COUNT(*) AS total_appearances,
      RANK() OVER (PARTITION BY type_1 ORDER BY COUNT(name) DESC
      ) AS rank_column
   FROM
      pokemon_final_spawns
   GROUP BY
      type_1,
      name
   ORDER BY
      type_1,
      COUNT(*) DESC
      )
SELECT
   type_1,
   name,
   total_appearances
FROM
   popular_types
WHERE
   rank_column = 1;
```

Run a select statement to validate the view was created properly.

```
SELECT * FROM popular_types_sf_vw;
```



type_1	name	total_appearances
Bug	Weedle	5352
Water	Magikarp	3090
Poison	Zubat	17444
Grass	Bellsprout	1278

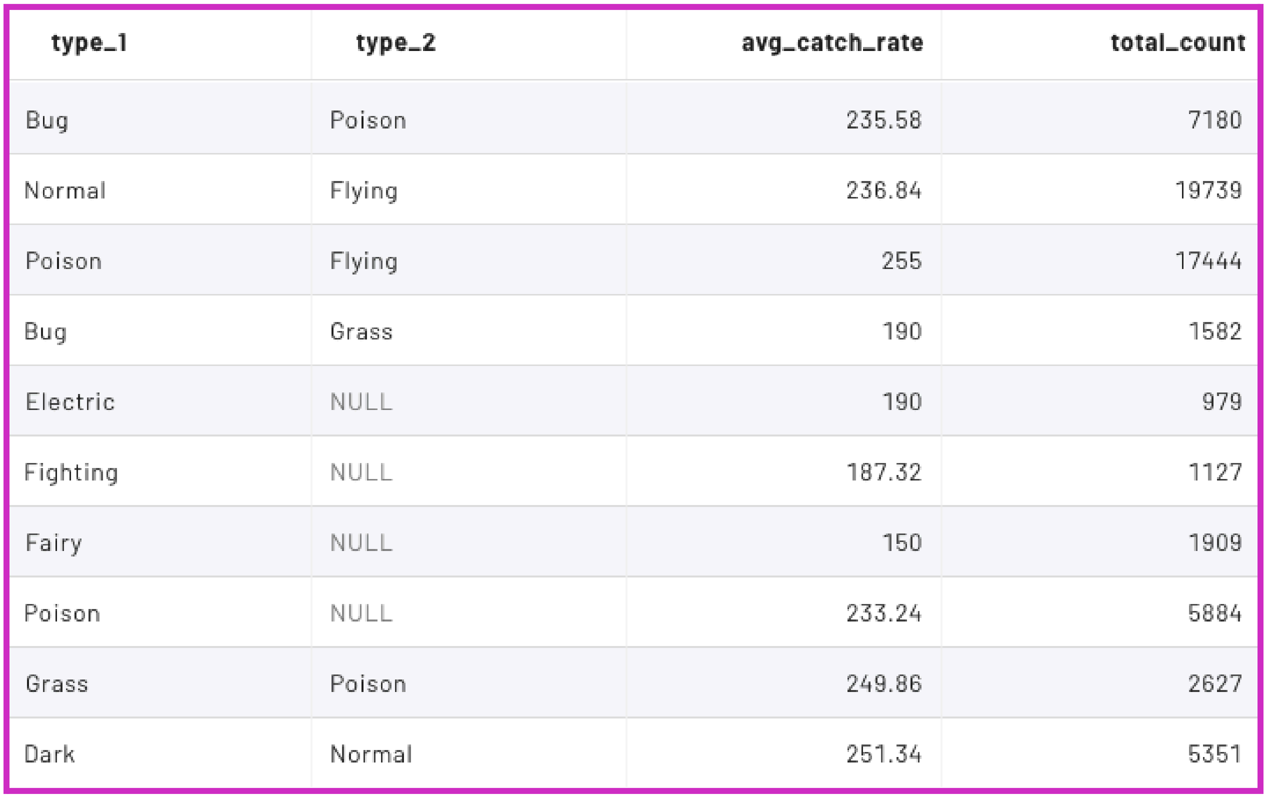
Step 5 - Create the second marketing view

Use a Grouping set to find the total number of Pokemon caught for each Type_1 and Type_2 pairing.

```
CREATE OR REPLACE VIEW counts_by_types_sf_vw AS
SELECT
      type_1,
      type_2,
      ROUND(AVG(catch_rate), 2) AS avg_catch_rate,
      COUNT(name) AS total_count
FROM
      pokemon_final_spawns
GROUP BY
      GROUPING SETS ((type_1, type_2))
ORDER BY
      type_1,
      total_count DESC;
```

Run a select statement to validate the view was created properly. The results should be similar to the image below.

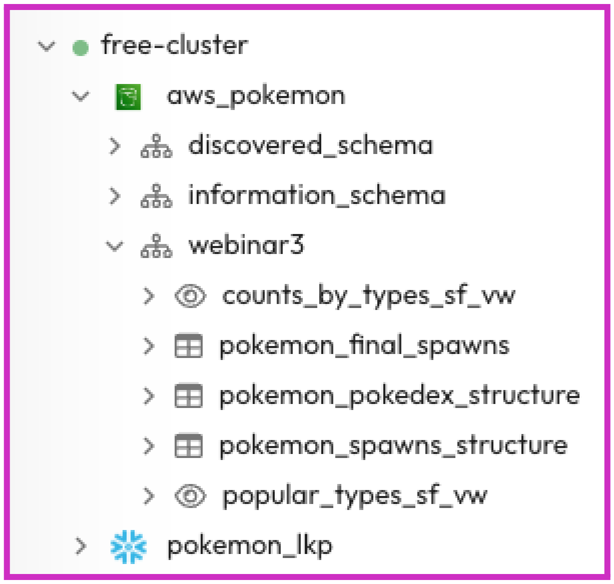
```
SELECT * FROM counts_by_types_sf_vw;
```



type_1	type_2	avg_catch_rate	total_count
Bug	Poison	235.58	7180
Normal	Flying	236.84	19739
Poison	Flying	255	17444
Bug	Grass	190	1582
Electric	NULL	190	979
Fighting	NULL	187.32	1127
Fairy	NULL	150	1909
Poison	NULL	233.24	5884
Grass	Poison	249.86	2627
Dark	Normal	251.34	5351

Step 6 - Visualize the structure and consume layers

Collapse and expand the `webinar3` schema to see the 3 structure tables and 2 consume views that you have created.



```
free-cluster
  aws_pokemon
    discovered_schema
    information_schema
    webinar3
      counts_by_types_sf_vw
      pokemon_final_spawns
      pokemon_pokedex_structure
      pokemon_spawns_structure
      popular_types_sf_vw
  pokemon_lkp
```

Part 5: Secure access to your consume layer

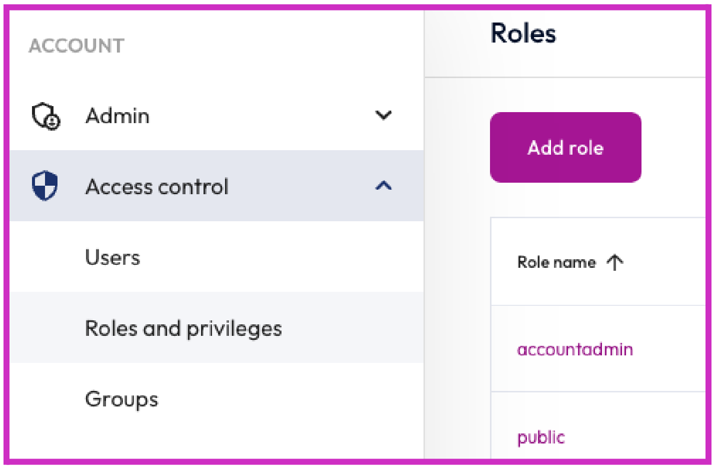
Objective

The consume layer has been created. Now it's time to ensure that access to this data is restricted to the appropriate users.

Step 1 - Create a marketing role

To restrict access to the consume layer, you're going to create a specific role for the marketing department. This will restrict access to the data to team members with the appropriate rights, and restrict their access to the two newly created views.

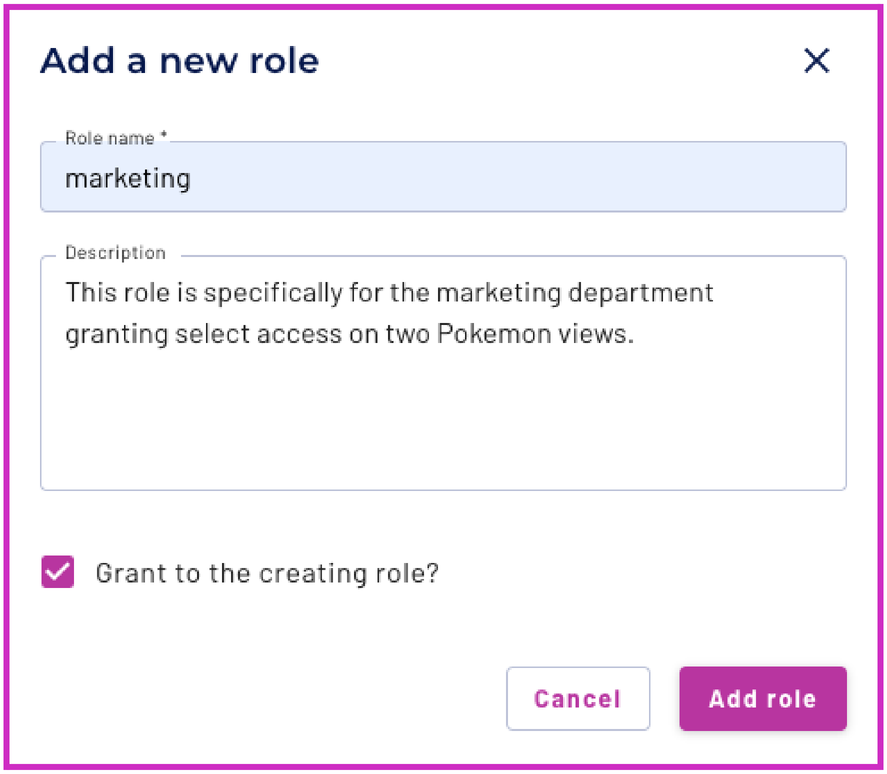
To do this, navigate to Access control near the bottom of the left navigation and select the **Roles and privileges** submenu item.



Role name ↑
accountadmin
public

Select **Add role** and enter the following information:

Role name: marketing
Description: This role is specifically for the marketing department granting select access to two aggregated views.
Grant to the creating role? Yes

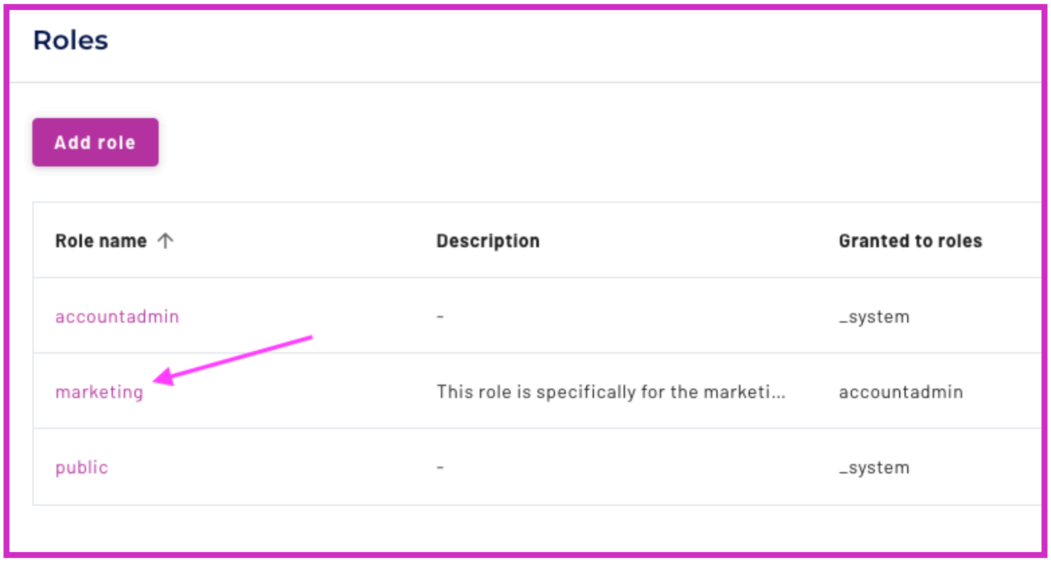


Role name *
marketing

Description
This role is specifically for the marketing department granting select access on two Pokemon views.

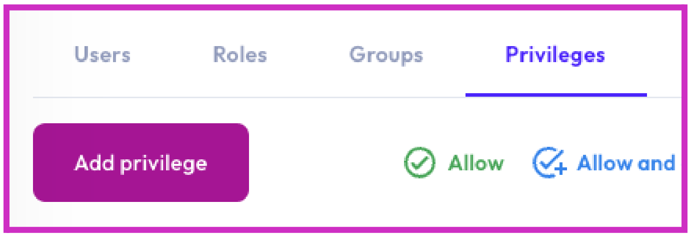
☑ Grant to the creating role?

Next, select the newly created marketing role. This allows you to assign proper privileges.

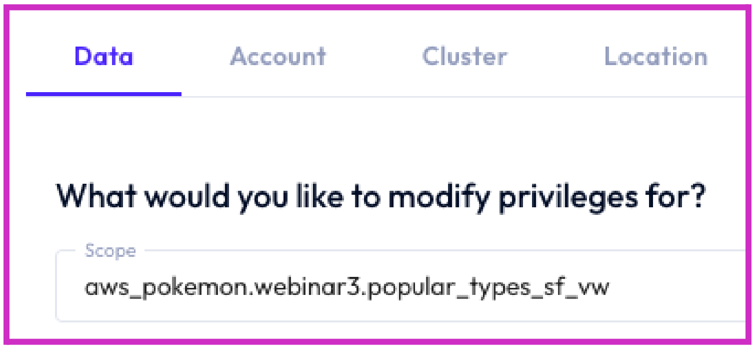


Role name ↑	Description	Granted to roles
accountadmin	-	_system
marketing	This role is specifically for the marketi...	accountadmin
public	-	_system

Navigate to the **Privileges** tab. Select **Add privilege**.



With the **Data** tab selected, use the explorer in the **What would you like to modify privileges for?** pulldown to be set to `aws_pokemon.webinar3.popular_types_sf_vw`.

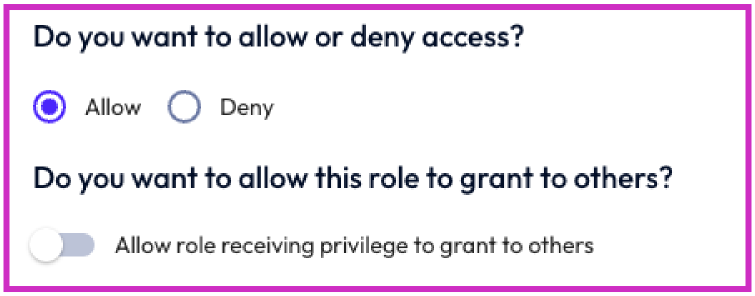


What would you like to modify privileges for?

Scope

aws_pokemon.webinar3.popular_types_sf_vw

Leave the default values for **allow/deny access** and **allow role to grant to others**.



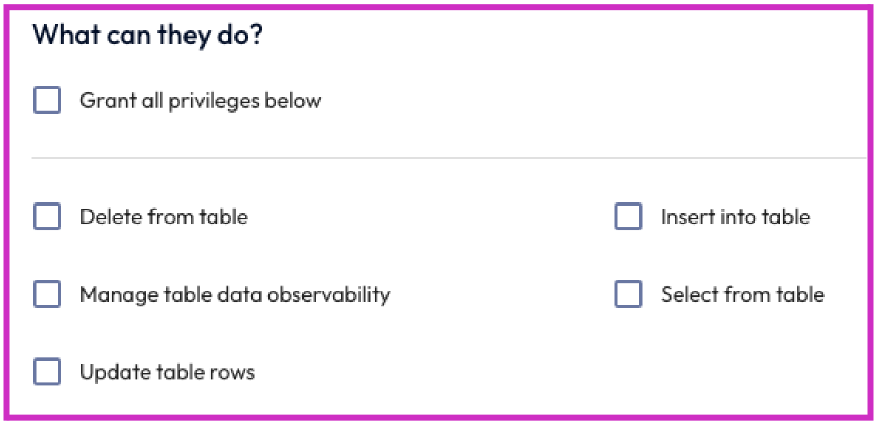
Do you want to allow or deny access?

● Allow ○ Deny

Do you want to allow this role to grant to others?

Allow role receiving privilege to grant to others

Scroll down if needed and then choose **Select from table** options in the bottom right of the **What can they do?** section.



What can they do?

□ Grant all privileges below

□ Delete from table

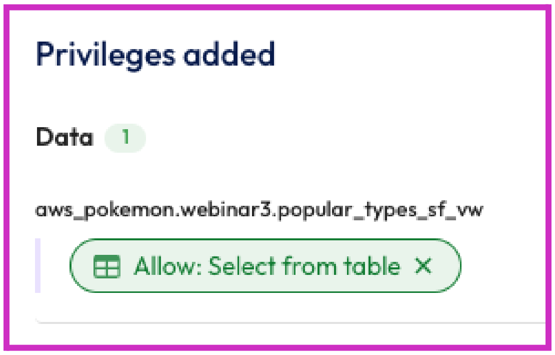
□ Insert into table

□ Manage table data observability

□ Select from table

□ Update table rows

The **Select from table** option will disappear once you select it. It will appear on the right, under **Privileges added**.

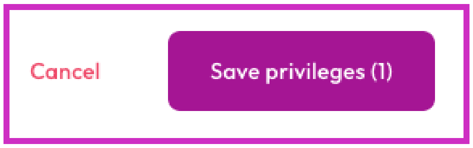


Privileges added

Data 1

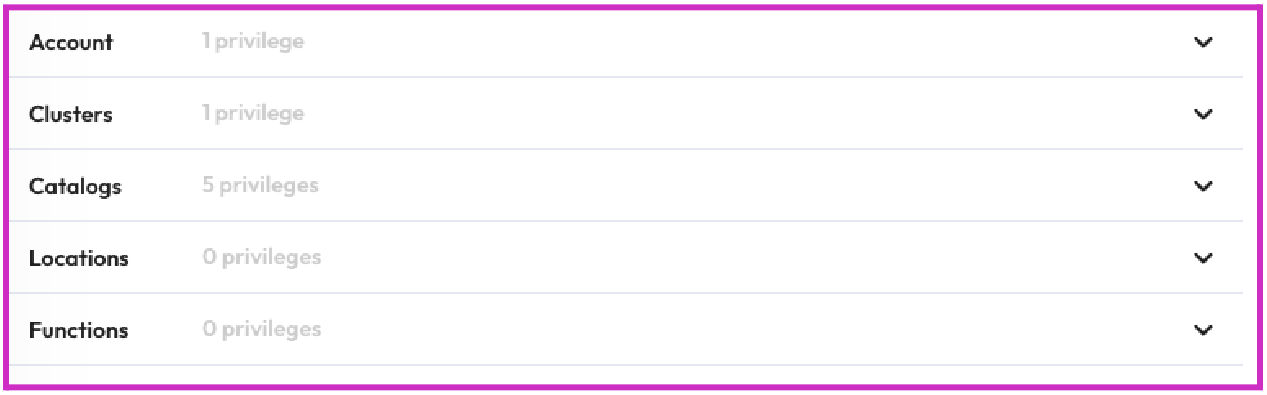
aws_pokemon.webinar3.popular_types_sf_vw

Press the **Save privileges** button below the information just presented.



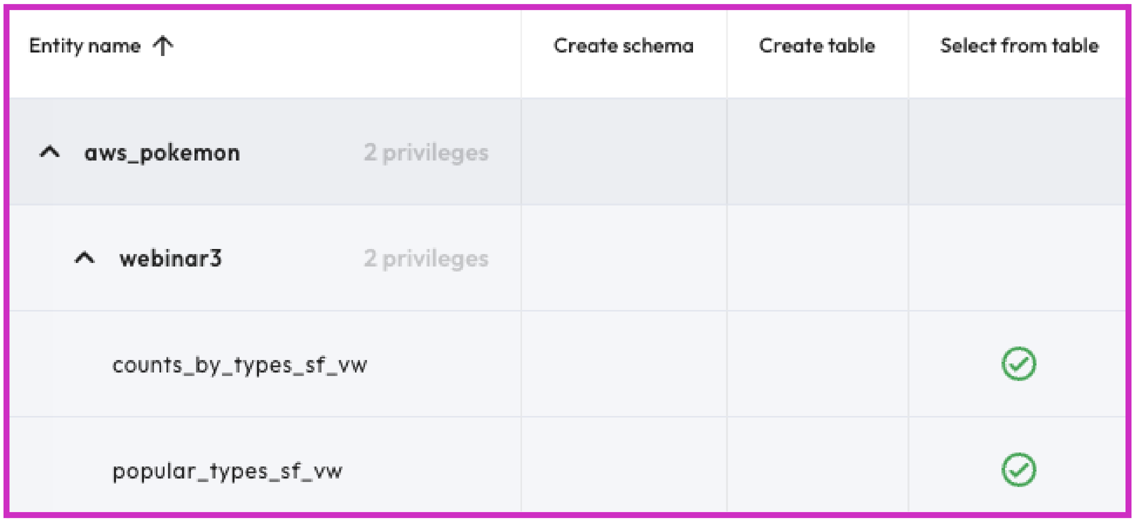
Repeat this process for `counts_by_types_sf_vw`.

Once back to the **Privileges** tab, expand the **Catalogs** line in the list below.



Account	1 privilege
Clusters	1 privilege
Catalogs	5 privileges
Locations	0 privileges
Functions	0 privileges

Toggling `aws_pokemon` and then `webinar3` will show you that the **Select from table** privilege has been granted to both views.

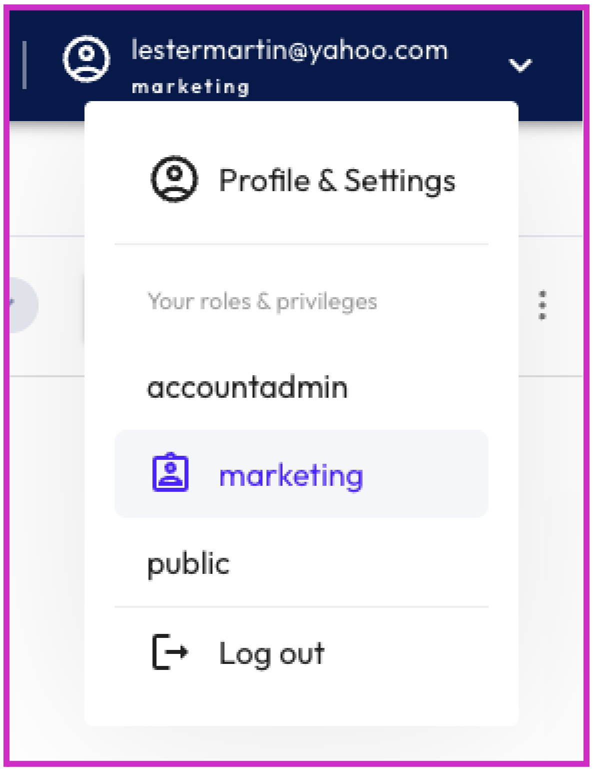


Entity name ↑		Create schema	Create table	Select from table
aws_pokemon	2 privileges			
webinar3	2 privileges			
counts_by_types_sf_vw				✓
popular_types_sf_vw				✓

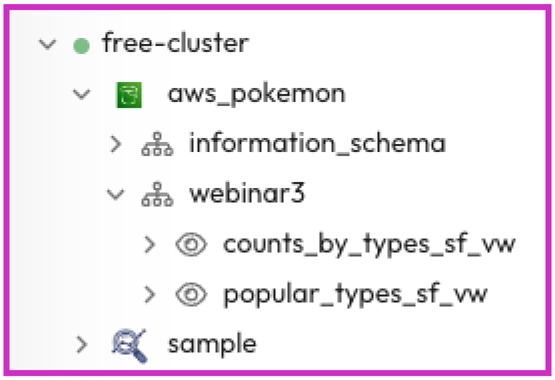
Step 2 - Test the marketing role

Now it’s time to test that the new role is working correctly.

Navigate back to the **Query editor** and switch to the **marketing** role in the top right-hand corner.



Notice that the cluster explorer shows only 2 views in the `webinar3` schema. This is exactly what you would expect. Additionally, the `pokemon_lkp` Snowflake catalog is not present.



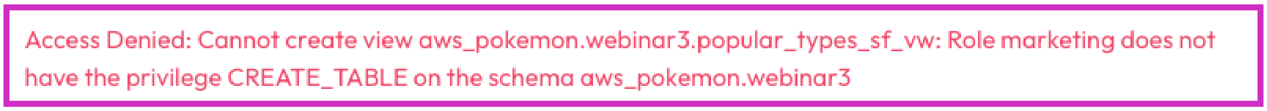
Run a select statement to validate the newly created role has access to view the tables.

```
SELECT * FROM counts_by_types_sf_vw;
```

Now, try recreating the `popular_types_sf_vw` view using the marketing role.

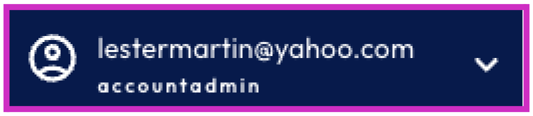
```
CREATE OR REPLACE VIEW popular_types_sf_vw AS
WITH
popular_types AS (
   SELECT
      type_1,
      name,
      COUNT(*) AS total_appearances,
      RANK() OVER (PARTITION BY type_1 ORDER BY COUNT(name) DESC
      ) AS rank_column
   FROM
      pokemon_final_spawns
   GROUP BY
      type_1,
      name
   ORDER BY
      type_1,
      COUNT(*) DESC
      )
SELECT
   type_1,
   name,
   total_appearances
FROM
   popular_types
WHERE
   rank_column = 1;
```

This will fail because you have only granted the marketing role select permissions.



Access Denied: Cannot create view aws_pokemon.webinar3.popular_types_sf_vw: Role marketing does not have the privilege CREATE_TABLE on the schema aws_pokemon.webinar3

Navigate back to the **accountadmin** role in the upper right-hand corner.



Lab 4: Create data products

Learning objectives

- Demonstrate how to execute a global search.
- Demonstrate how to create a data product.
- Demonstrate how to create tags.

Prerequisites

- Lab 1: Introduction and setup
- Lab 2: Connect to data sources
- Lab 3: Build within your data lake

Activities

1. Execute global search
2. Create a data product
3. Create tags

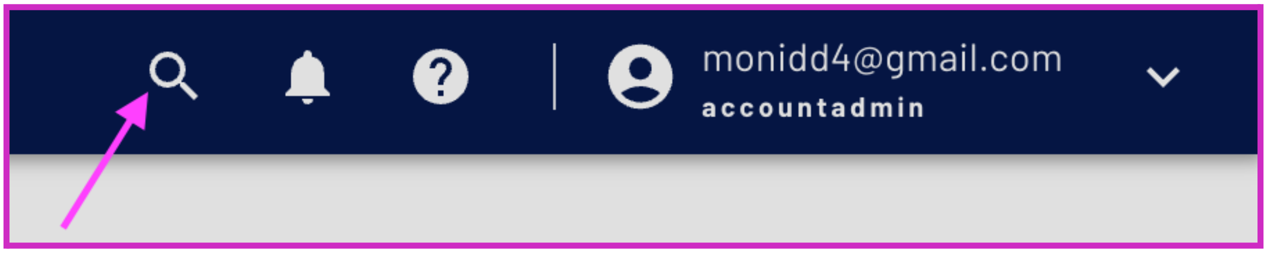
Part 1: Execute global search

Objective

Global search lets users find datasets quickly and intuitively. It is a powerful tool that helps keep better track of your data.

Step 1 - Navigate Starburst UI

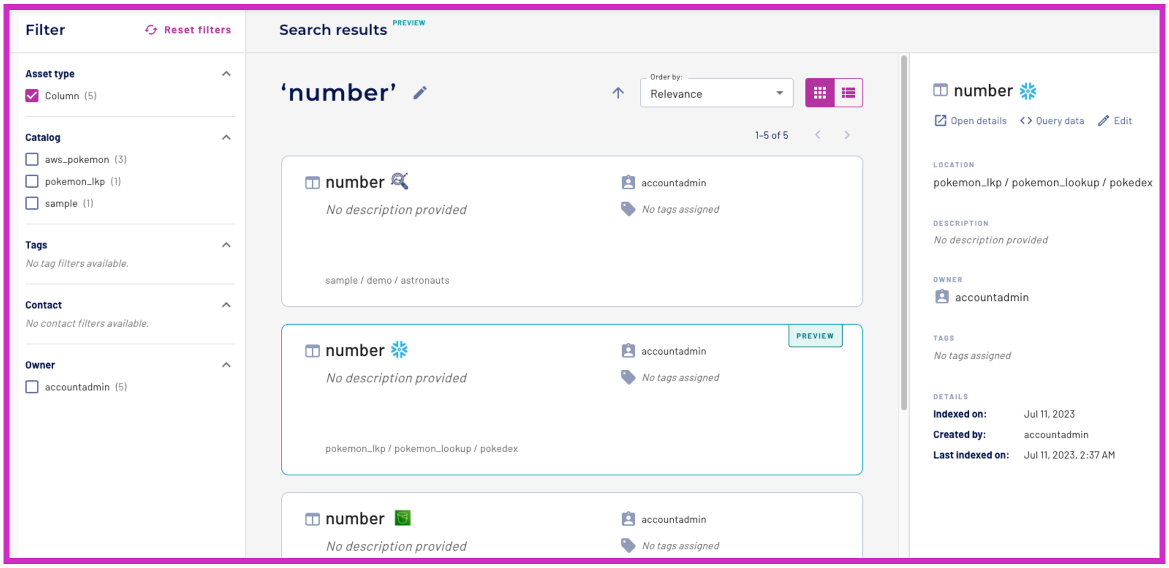
To use global search, select the magnifying glass icon in the upper-right corner.



Step 2 - Execute global search

Enter the word `number` and select **View all results** at the bottom of the pop-up window.

Starburst Galaxy displays multiple instances matching your search criteria drawn from multiple data sources. Some occur in tables and views you created throughout the lab. Others are simply populated through your catalog connection.



number
No description provided
accountadmin
No tags assigned
sample / demo / astronauts

number
No description provided
accountadmin
No tags assigned
pokemon_lkp / pokemon_lookup / pokedex

number
No description provided
accountadmin
No tags assigned

number

LOCATION
pokemon_lkp / pokemon_lookup / pokedex

DESCRIPTION
No description provided

OWNER
accountadmin

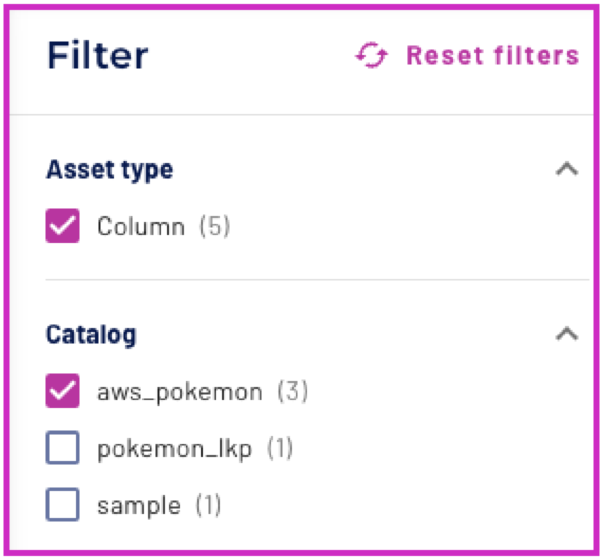
TAGS
No tags assigned

DETAILS
Indexed on: Jul 11, 2023
Created by: accountadmin
Last indexed on: Jul 11, 2023, 2:37 AM

Step 3 - Filter global search

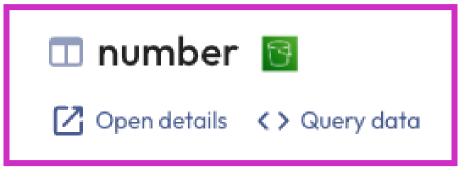
Global search can also be filtered to help refine your search.

Select the Catalog filter for `aws_pokemon` on the left to see how different search criteria impact the results.

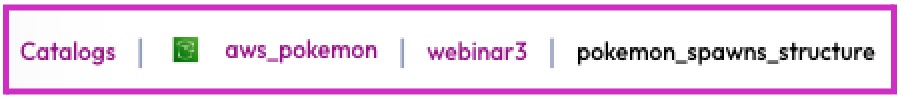


Step 3 - Navigate to your newly created view

Select **Open details** on the far right for any of the `aws_pokemon` results.



Notice that Starburst Galaxy automatically routes you to the **Catalogs** page. Navigate to your webinar3 schema by clicking on it.


Catalogs | aws_pokemon | webinar3 | pokemon_spawns_structure

The information for the entire schema is available to you, including **Tables**, **Views**, **Metrics**, **Definition**, **Query history**, and **Privileges**. Navigate through each tab to see the available features.

Part 2: Create a data product

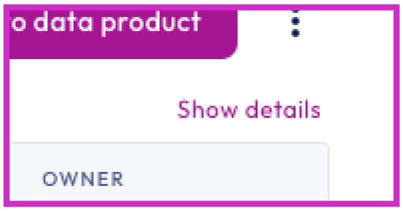
Objective

Now it's time to create a data product using your datasets. Data products curate data in a way that makes it more accessible and useful, and can be shared across teams.

Step 1 - Enter additional information

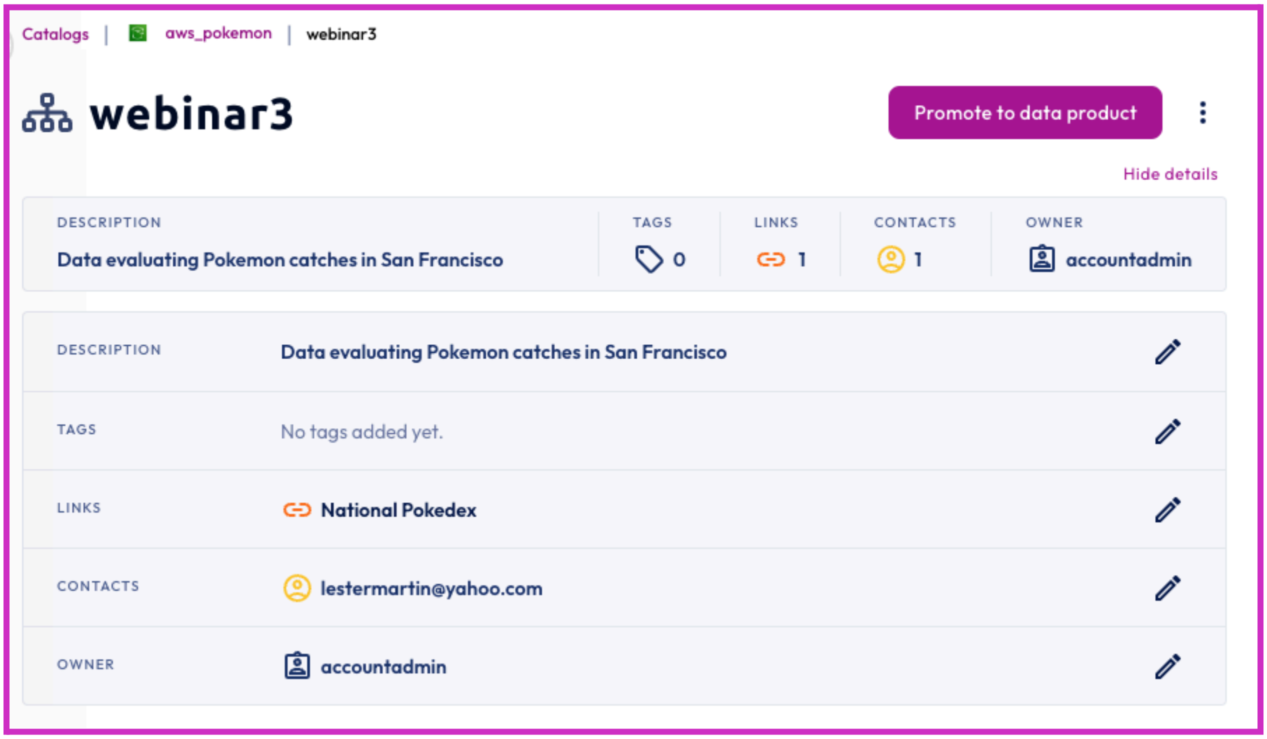
Make sure you are in your schema as mentioned in the previous step. Before creating a data product, enter some information into your catalog.

Select **Show details** on the right-hand side.



Edit the following information:

Description: Data evaluating Pokemon catches in San Francisco.
Links: Text to display: National Pokedex
Link URL: https://www.serebii.net/pokemon/nationalpokedex.shtml
Contacts: yourname

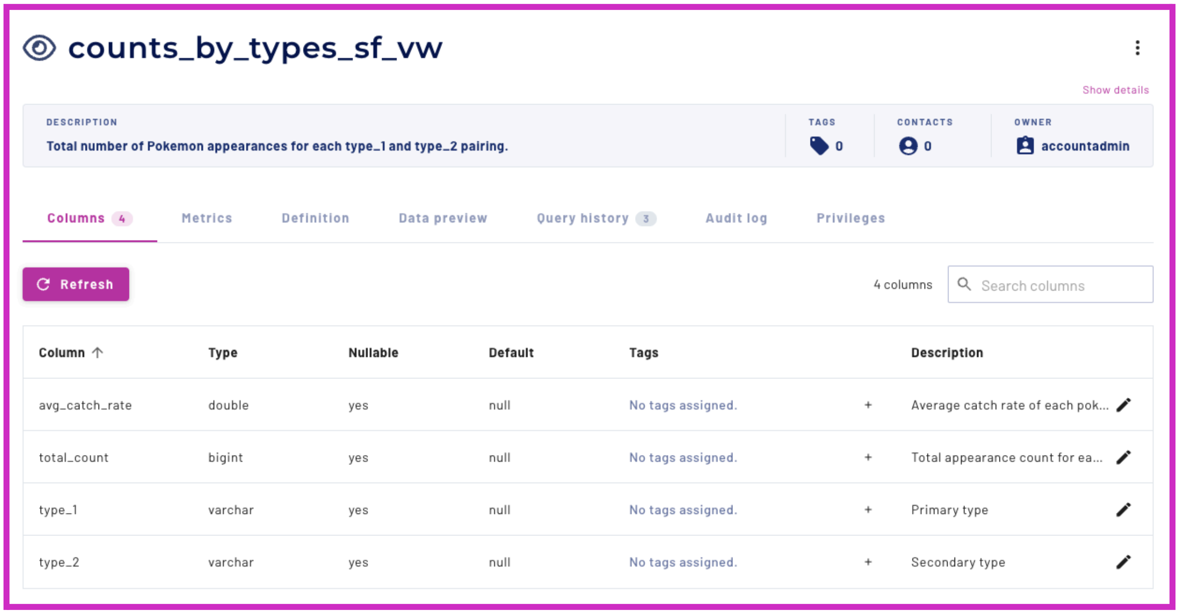


webinar3

DESCRIPTION	TAGS	LINKS	CONTACTS	OWNER
Data evaluating Pokemon catches in San Francisco	0	1	1	accountadmin

DESCRIPTION	Data evaluating Pokemon catches in San Francisco
TAGS	No tags added yet.
LINKS	National Pokedex
CONTACTS	lestermartin@yahoo.com
OWNER	accountadmin

If you have extra time, go through the tables and views created and add meaningful descriptions to each table/view and the columns within them.



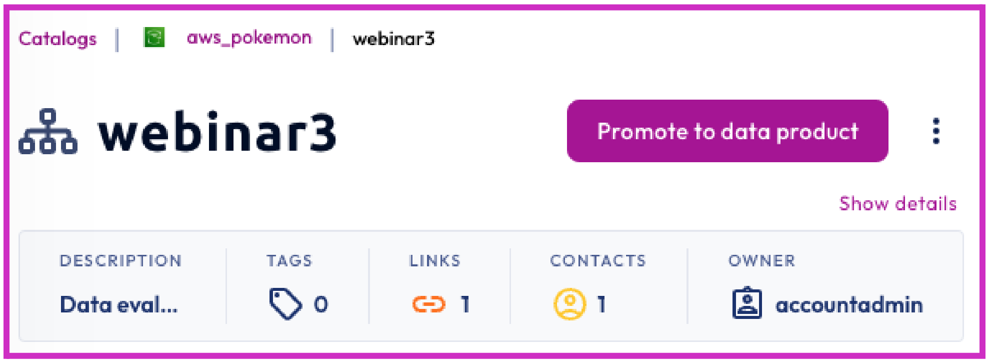
counts_by_types_sf_vw

DESCRIPTION	TAGS	CONTACTS	OWNER
Total number of Pokemon appearances for each type_1 and type_2 pairing.	0	0	accountadmin

Column ↑	Type	Nullable	Default	Tags		Description
avg_catch_rate	double	yes	null	No tags assigned.	+	Average catch rate of each pok...
total_count	bigint	yes	null	No tags assigned.	+	Total appearance count for ea...
type_1	varchar	yes	null	No tags assigned.	+	Primary type
type_2	varchar	yes	null	No tags assigned.	+	Secondary type

Step 2 - Promote your data product

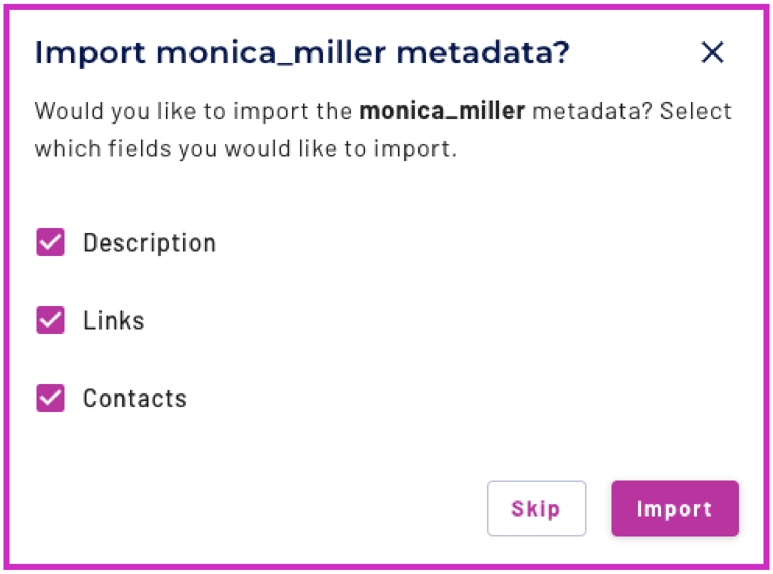
Navigate back to your schema and select **Promote to data product**.



webinar3

DESCRIPTION	TAGS	LINKS	CONTACTS	OWNER
Data eval...	0	1	1	accountadmin

Import all the information you've already added to the schema. Select **Import**.



Import monica_miller metadata?

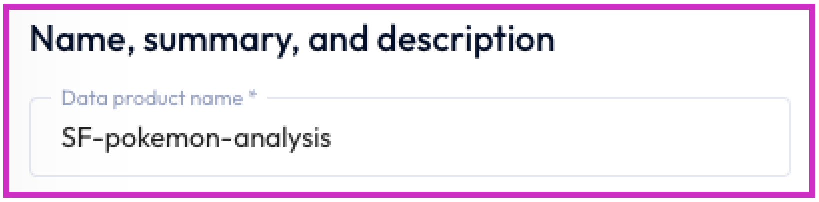
Would you like to import the **monica_miller** metadata? Select which fields you would like to import.

☑ Description

☑ Links

☑ Contacts

Add a descriptive name like `SF-pokemon-analysis` for the **Data product name** input field.



Name, summary, and description

Data product name *: SF-pokemon-analysis

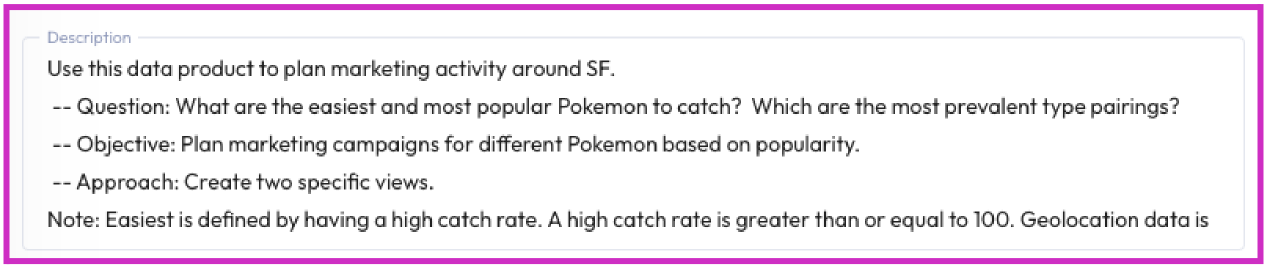
The summary has already been populated based on the information you added to the schema.

Add the following description:

Use this data product to plan marketing activity around SF.

- **Question:** What are the easiest and most popular Pokemon to catch? Which are the most prevalent type pairings?
- **Objective:** Plan marketing campaigns for different Pokemon based on popularity.
- **Approach:** Create two specific views.

Note: Easiest is defined by having a high catch rate. A high catch rate is greater than or equal to 100. Geolocation data is filtered to only be within the San Francisco Bay Area.



Description

Use this data product to plan marketing activity around SF.

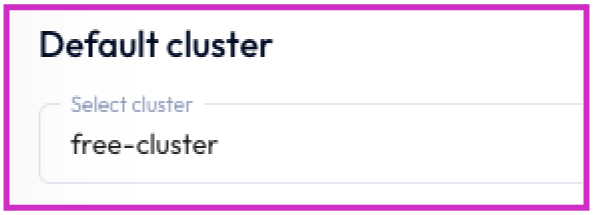
-- Question: What are the easiest and most popular Pokemon to catch? Which are the most prevalent type pairings?

-- Objective: Plan marketing campaigns for different Pokemon based on popularity.

-- Approach: Create two specific views.

Note: Easiest is defined by having a high catch rate. A high catch rate is greater than or equal to 100. Geolocation data is

Select `free-cluster` as the **Default cluster**.

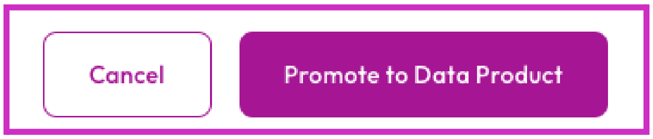


Default cluster

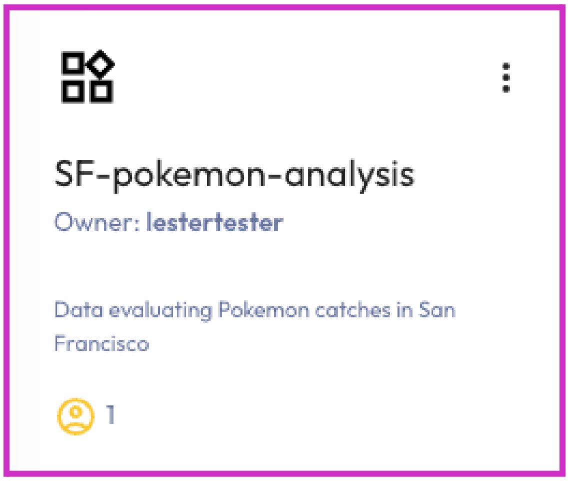
Select cluster

free-cluster

The **Contacts** and **Supporting information** have been automatically populated from the schema. Select **Promote to data product**.



Congratulations! You have created and promoted your first data product. You were routed to the Data products page where you can view your work.



SF-pokemon-analysis

Owner: lestertester

Data evaluating Pokemon catches in San Francisco

Part 3: Create tags (Bonus)

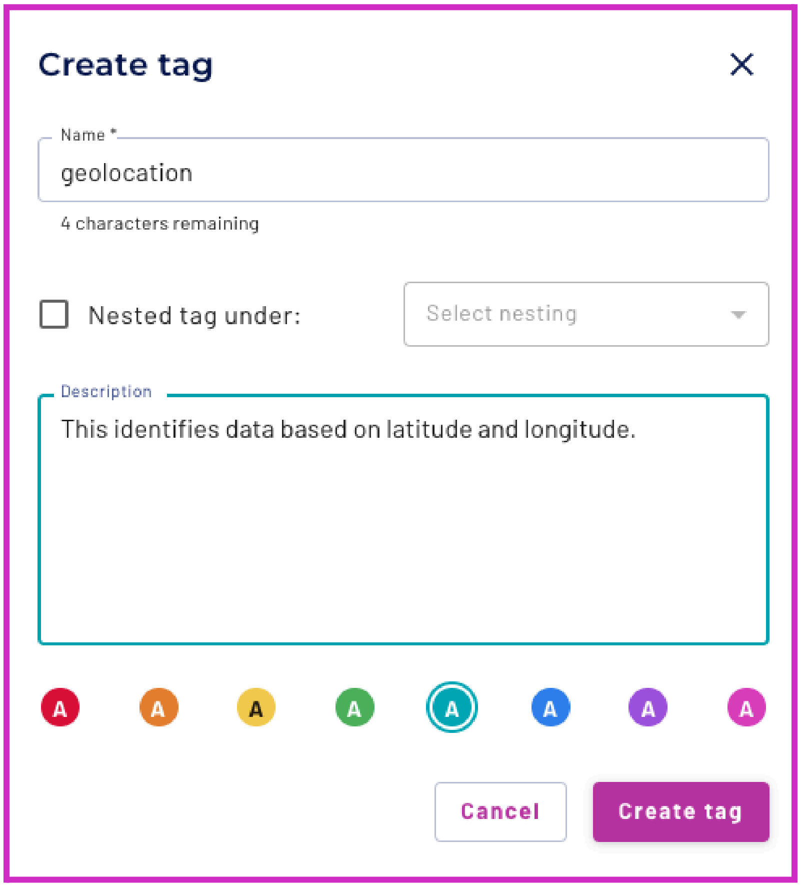
Objective

Last step. It's time to create tags. These can be used to identify the attributes of a dataset so they can be easily searched later. Tagging is flexible and allows you to create the level of granularity that works best for you. Tags can be assigned to the data product, the tables/views within the data product, or the columns within the tables/views.

Step 1 - Create a new tag

Navigate to Admin in the left nav and then select the **Tags** submenu item. Select **Create tag** then fill in the input fields as identified below.

Name: geolocation
Description: This identifies data based on latitude and longitude.
Color: Your choice



Create tag

Name *: geolocation

4 characters remaining

□ Nested tag under: Select nesting

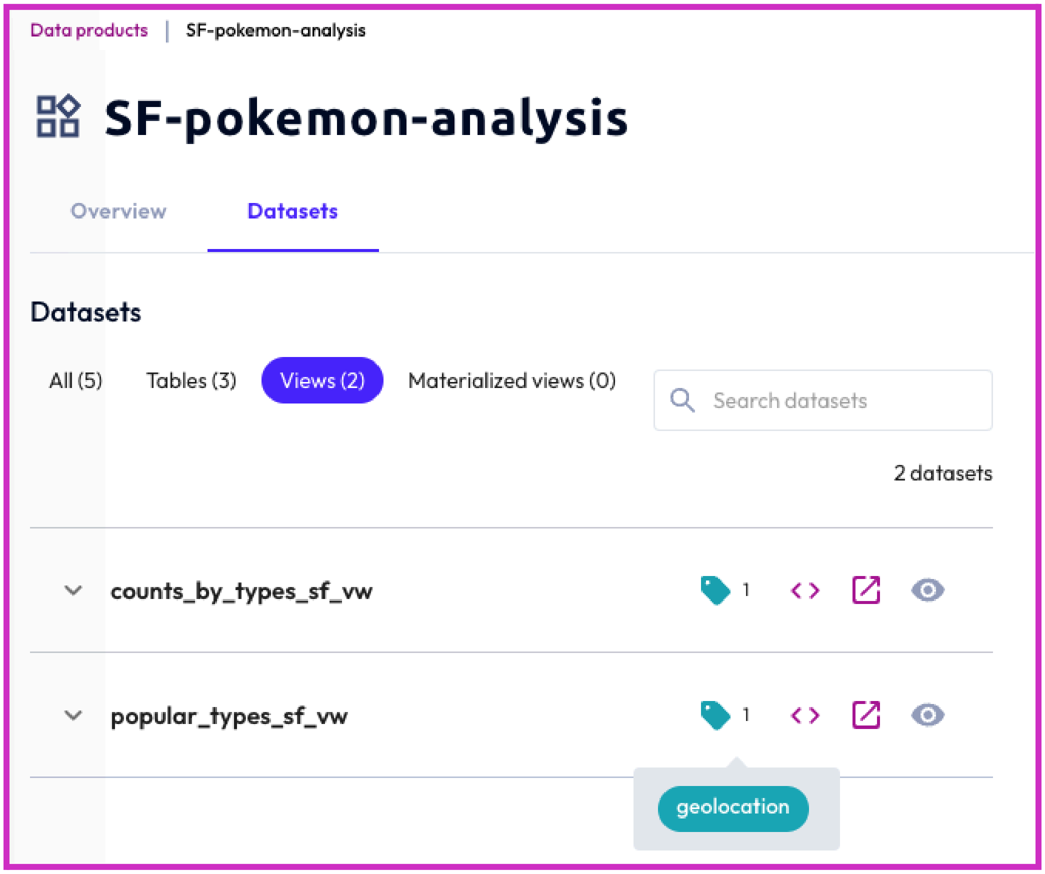
Description: This identifies data based on latitude and longitude.

Step 2 - Assign the new tag appropriately

Your mission is to navigate to both views within the data product you created and correctly assign the tag to the created views. Can you figure it out on your own?

Hint: Assign the tags in the **Catalogs** page then verify they are present in the **Data products** page.

Your results should look like following. Ask for help if you need it! :)



If you have more time, add additional information to your data product to make it a more meaningful and curated dataset for your end users.