Amazon Web Services
Data Engineering Immersion Day

Lab 4. AWS Lake Formation
August 2020

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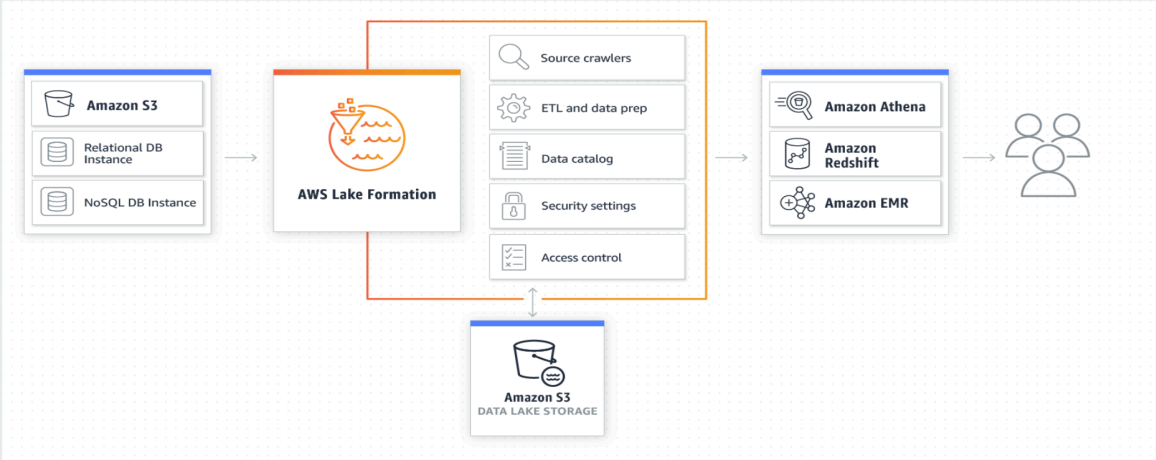
Introduction

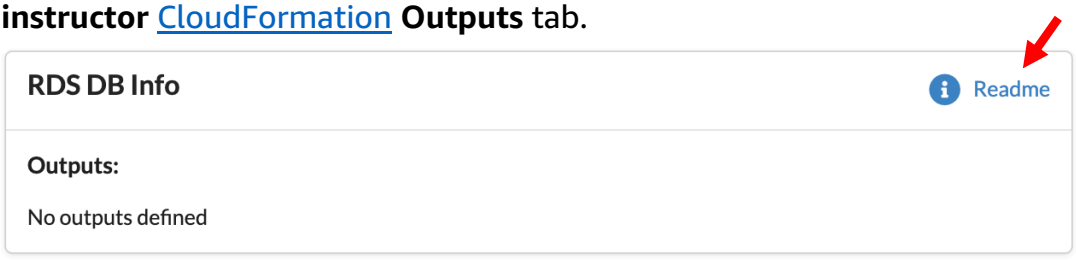
This lab will give you an understanding of the AWS Lake Formation – a service that makes it easy to set up a secure data lake, as well as Athena for querying the data you import into your data lake.



Today, you are attending a formal AWS event. If in the future you might want to perform these labs in your own AWS environment by yourself, you can follow instructions here - https://aws-dataengineering-day.workshop.aws/en/1200.html

Prerequisites

1. Make sure you have the Postgres source database information from your Event Dashboard handy. If you are running the lab outside of AWS hosted event, please find the **DMSInstanceEndpoint** parameter value from **dmslab-instructor** CloudFormation **Outputs** tab.



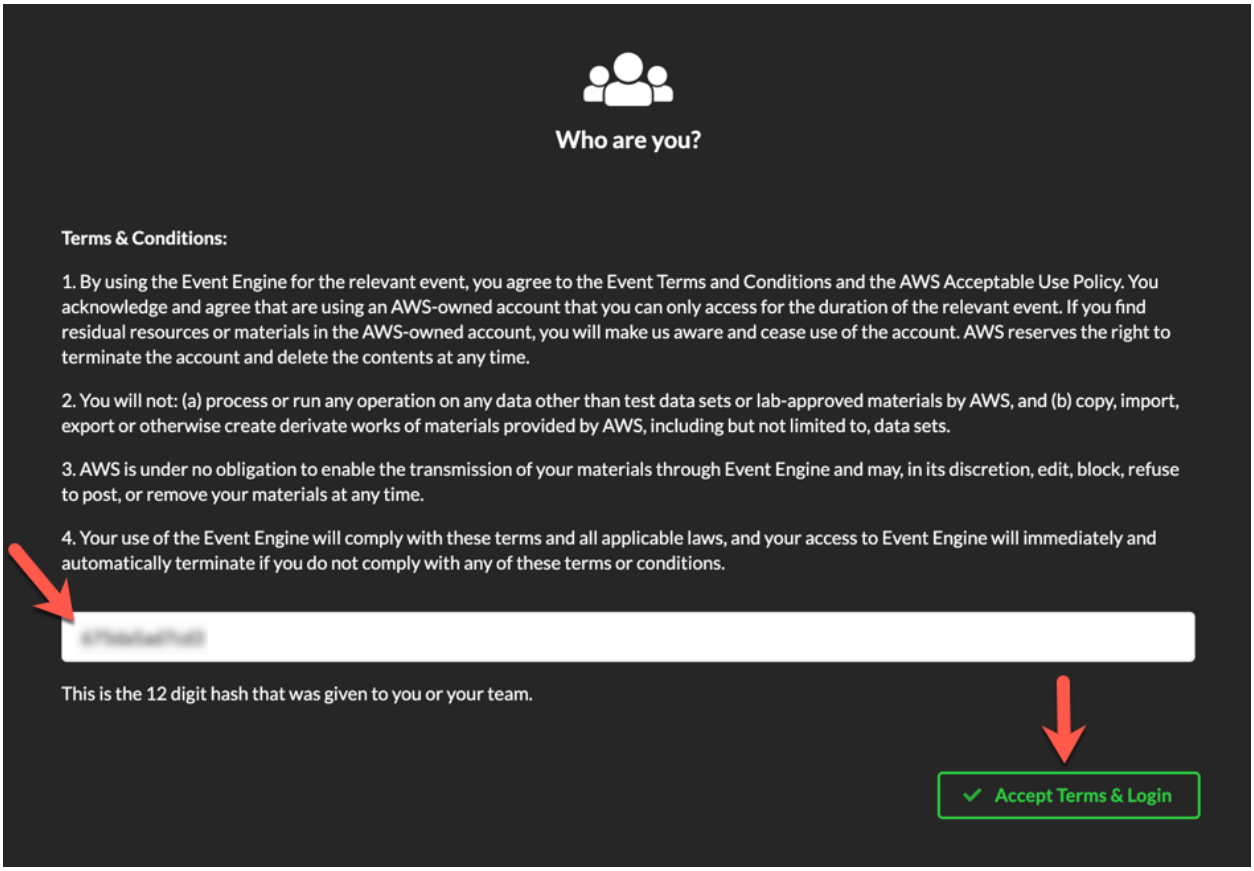
2. Completed Lab 1. Hydrating the Data Lake with DMS
3. Completed Lab 2. ETL with AWS Glue

Get Started Using the Lab Environment

Please skip this section if you are running the lab on your own AWS account.

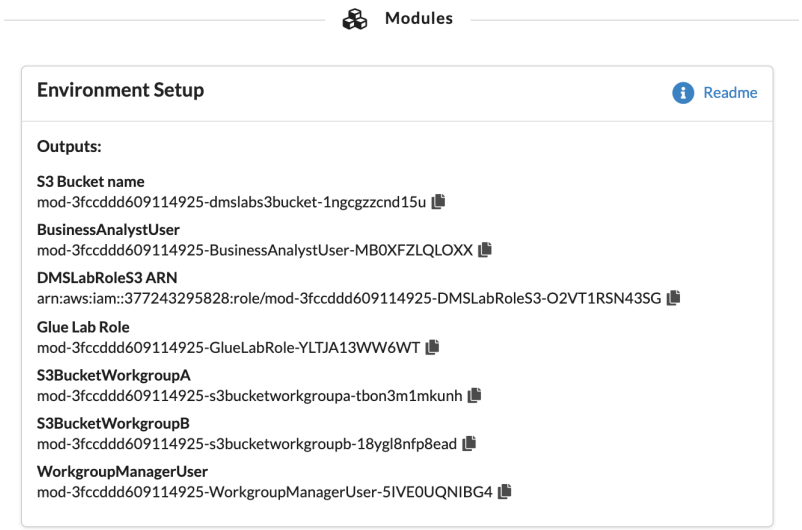
Today, you are attending a formal event and you will have been sent your access details beforehand. If in the future you might want to perform these labs in your own AWS environment by yourself, you can follow instructions on GitHub - https://github.com/aws-samples/data-engineering-for-aws-immersion-day.
A 12-character access code (or 'hash') is the access code that grants you permission to use a dedicated AWS account for the purposes of this workshop.

1. Go to https://dashboard.eventengine.run/, enter the access code and click Proceed:

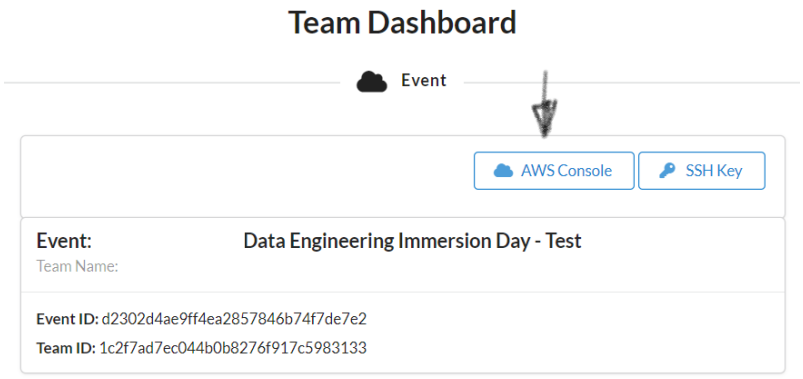


2. On the Team Dashboard web page you will see a set of connection strings and parameters that you will need during the labs. Best to save them to a text file locally, alternatively you can always go to this page to review them. Replace the parameters with the corresponding values from here where indicated in subsequent labs:

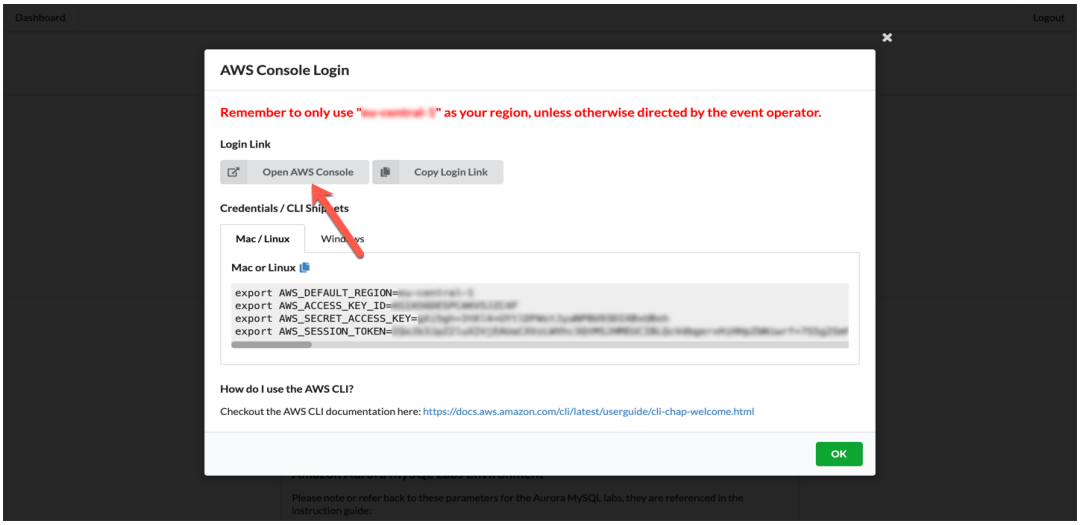
   Because you're at a formal event, some AWS resources have been pre-deployed for your convenience, for example



3. On the Team Dashboard, please click AWS Console to log into the AWS Management Console:



4. Click Open Console. For the purposes of this workshop, you will not need to use command line and API access credentials



Once you have completed these steps, you can continue with the rest of this lab.

Setup Network Configuration for AWS Glue

If you use Amazon Virtual Private Cloud (Amazon VPC) to host your AWS resources, you can establish a private connection between your VPC and AWS Glue. You use this connection to enable AWS Glue to communicate with the resources in your VPC without going through the public internet.

Amazon VPC is an AWS service that you can use to launch AWS resources in a virtual network that you define. With a VPC, you have control over your network settings, such the IP address range, subnets, route tables, and network gateways. To connect your VPC to AWS Glue, you define an interface VPC endpoint for AWS Glue. When you use a VPC interface endpoint, communication between your VPC and AWS Glue is conducted entirely and securely within the AWS network.

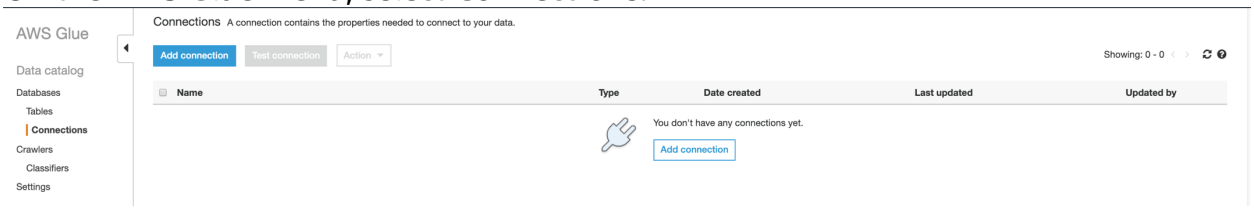
Create an IAM role to use with Lake Formation:

With AWS Lake Formation, you can import your data using *workflows*. A workflow defines the data source and schedule to import data into your data lake. You can easily define workflows using *blueprints*, or templates, that Lake Formation provides.

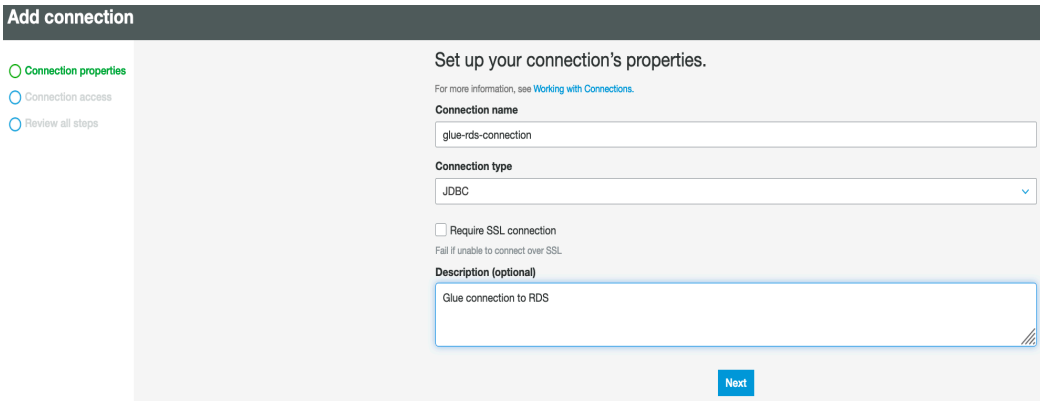
When you create a workflow, you must assign it an AWS Identity and Access Management (IAM) role that enables Lake Formation to set up the necessary resources on your behalf to ingest the data. In this lab, we've pre-created an IAM role for you, called **`<random>-LakeFormationWorkflowRole-<random>`**

Create Glue JDBC connection for RDS

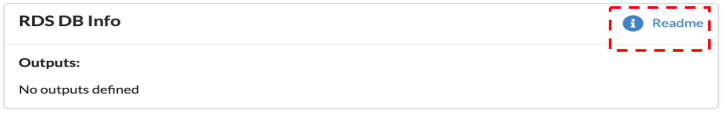
1. Navigate to the AWS Glue console: https://console.aws.amazon.com/glue/home?region=us-east-1
2. On the AWS Glue menu, select **Connections**.



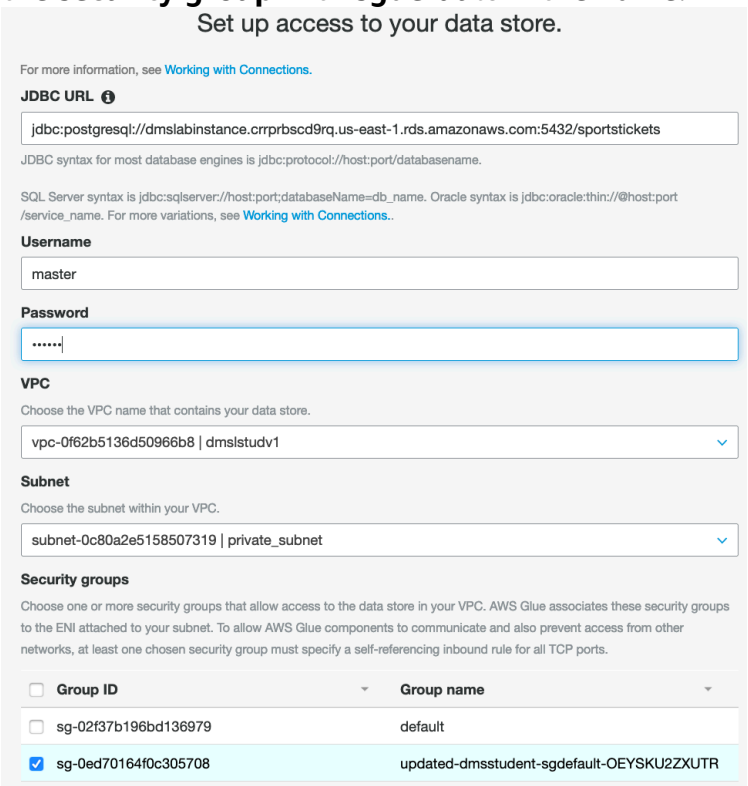
3. Click **Add Connection**.
4. Enter **glue-rds-connection** as the connection name.
5. Choose **JDBC** for connection type.
6. Optionally, enter the description. This should also be descriptive and easily recognized and Click **Next**.



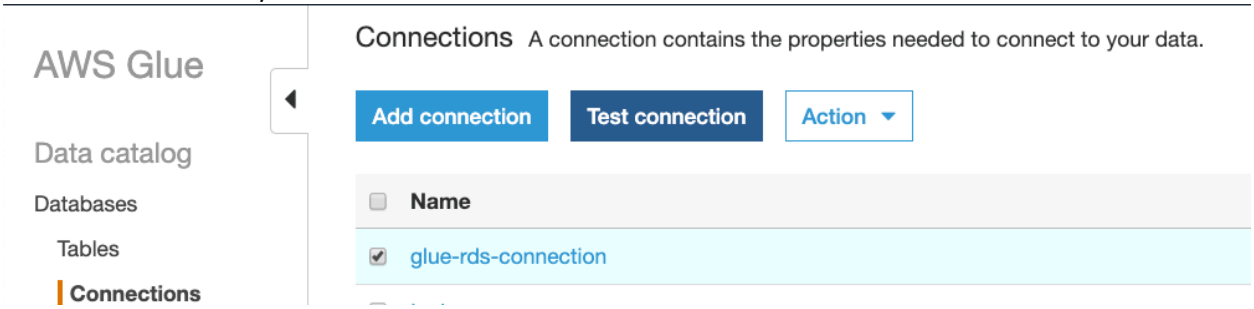
7. Input **JDBC URL** with the format of **jdbc:postgresql://[RDS_Server_Name] 5432/sportstickets**.
    a. Get the **RDS_Server_Name** from **RDS DB Info** dashboard.



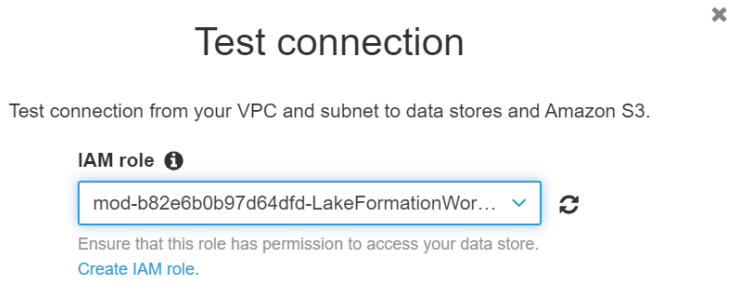
    b. If you are running the lab outside of AWS event, find the **DMSInstanceEndpoint** value on the **dmslab-instructor** CloudFormation **Outputs** tab.
8. Enter **master** as username, **master123** as **Password**
9. For **VPC**, select the pre-created VPC ending with **dmslstudv1**
10. For **Subnet,** choose one of **private_subnet**
11. Select the **security group** with **sgdefault** in the name.



12. Click **Next to** complete the **glue-rds-connection** setup. To test it, select the connection, and choose **Test connection**.

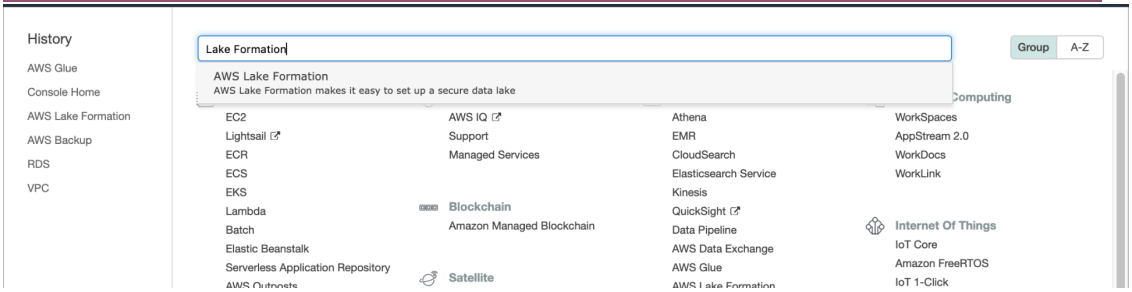


13. Choose the pre-created IAM role called **<random>-LakeFormationWorkflowRole-<random>** and then click **Test Connection.**

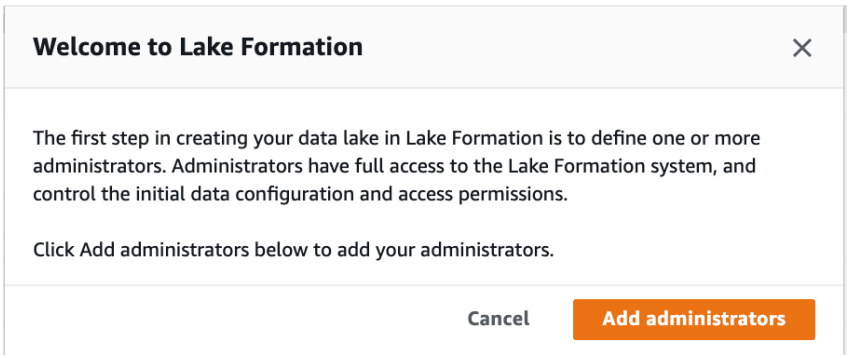


Lake Formation – Add Administrator and start workflows using Blueprints.

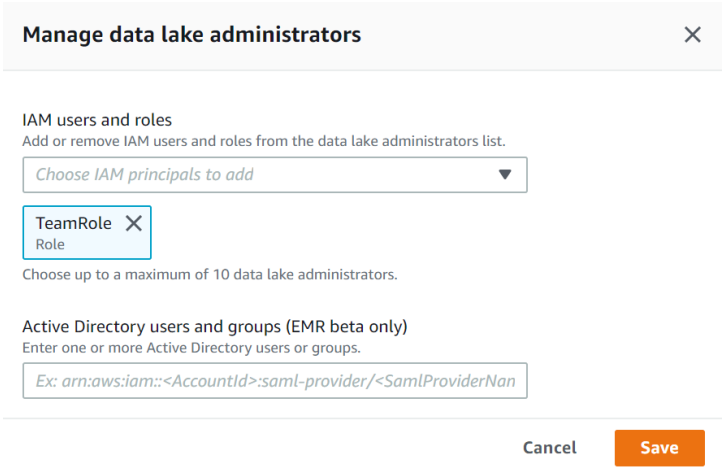
Navigate to the AWS Lake Formation service:
https://console.aws.amazon.com/lakeformation/home?region=us-east-1#databases



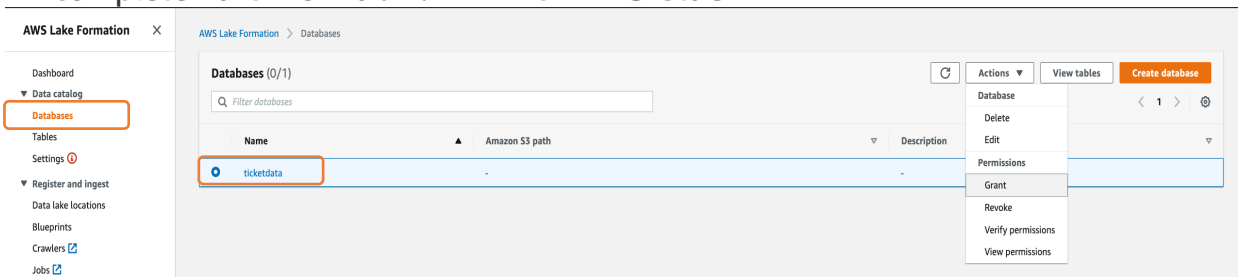
1. If you are logging into the lake formation console for the first time then you must add administrators first in order to do that follow Steps 2 and 3. Else skip to Step 4.
2. Click **Add administrators**



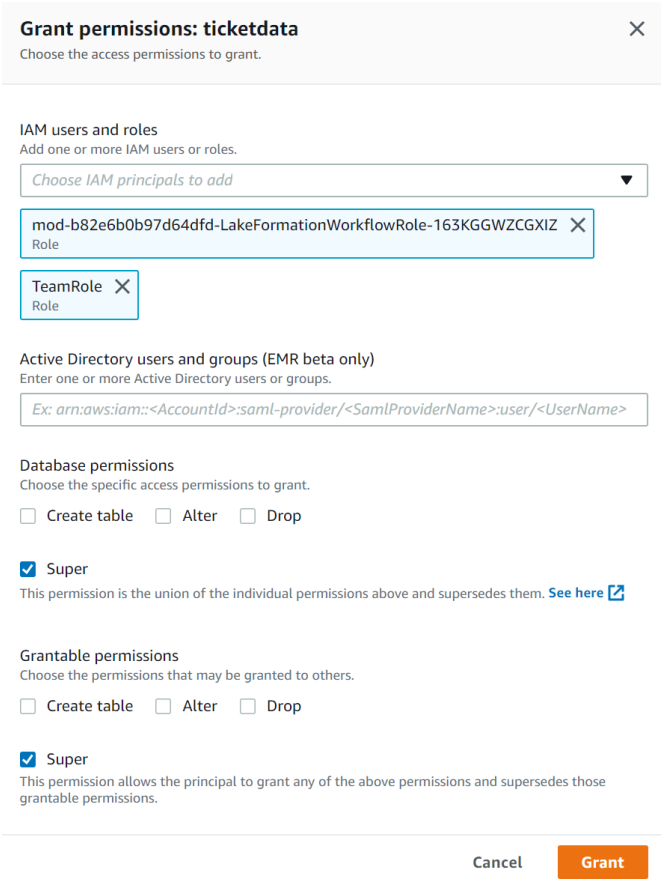
3. Add **TeamRole** Role as the Lake Formation Administrator and Click **Save**



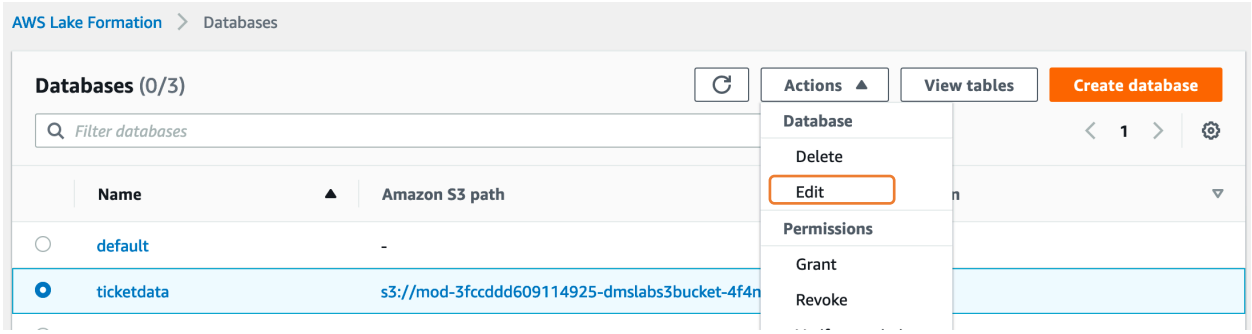
4. Navigate to **Databases** on left pane. Select **ticketdata** and click on **Actions**, select **Grant** to grant permissions. If you can't see any databases, make sure to complete **Part A of Lab 2. ETL with AWS Glue**



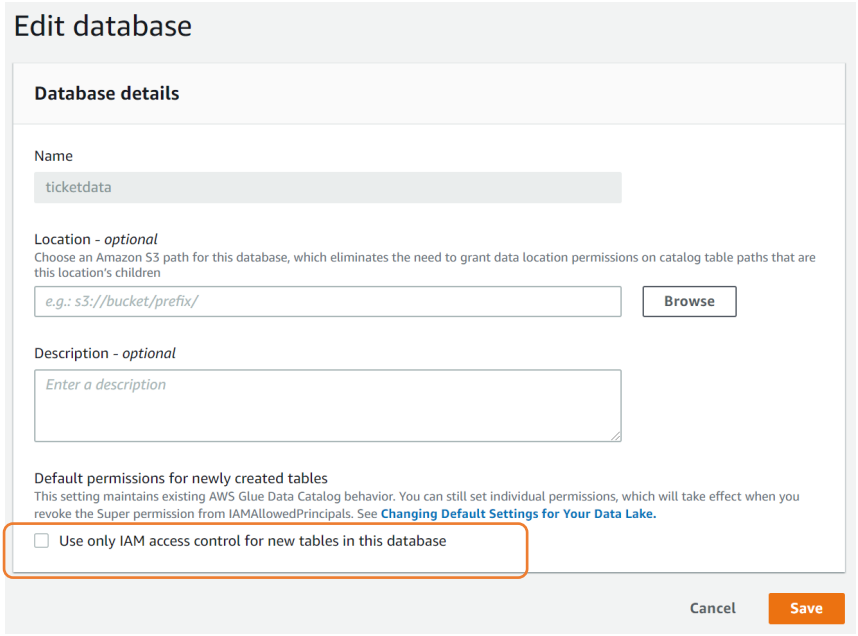
5. Under "**IAM Users and Roles**", select two roles: the Lake Formation role that was pre-created: **<random>-LakeFormationWorkflowRole-<random>** and **TeamRole**. Grant **super** permissions for **Database permissions and Grantable permissions.**



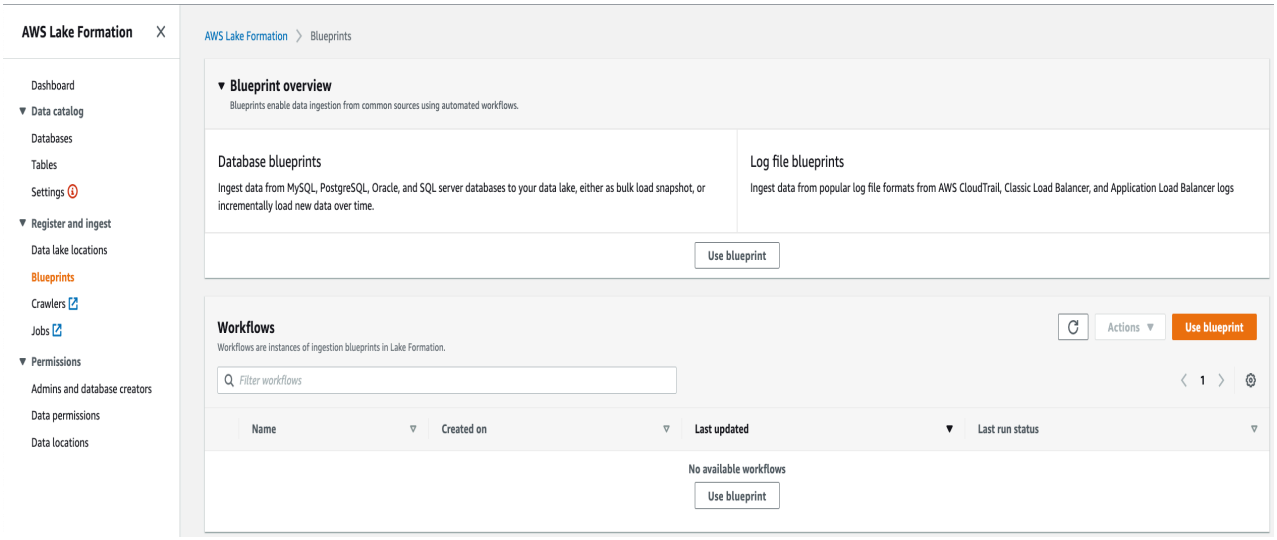
6. Select **Actions->Edit** on the **ticketdata** database



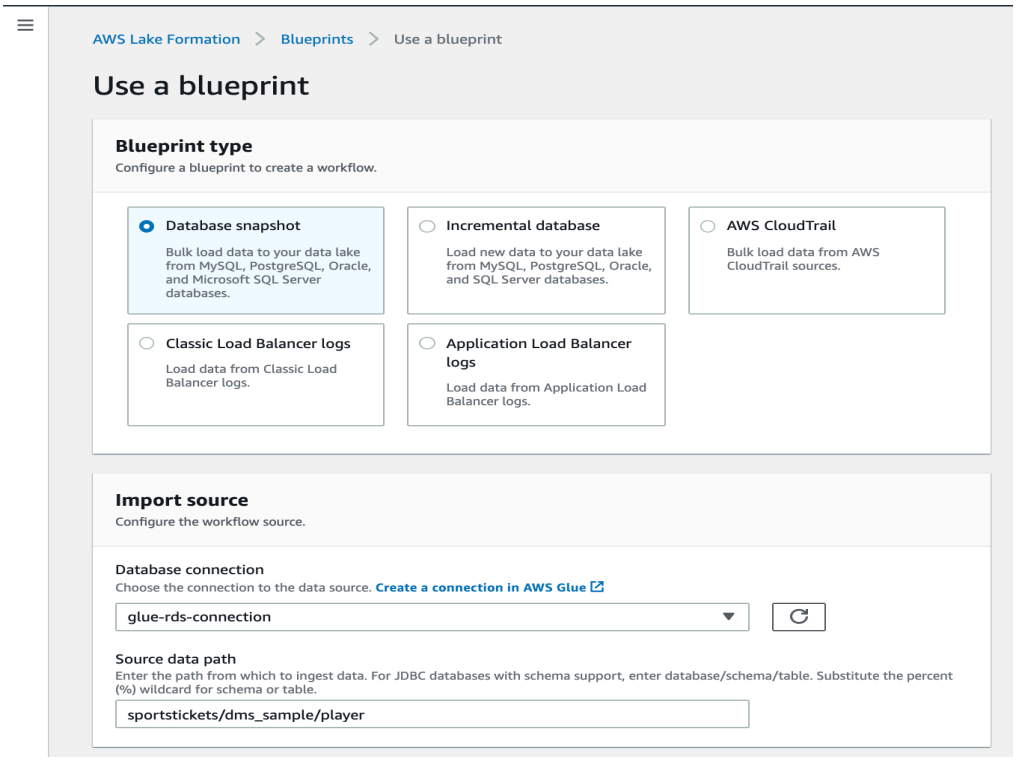
7. Clear the checkbox **Use only IAM access control** and click **Save**. Changing the default security setting so that access to Data Catalog resources (databases and tables) is managed by Lake Formation permissions.



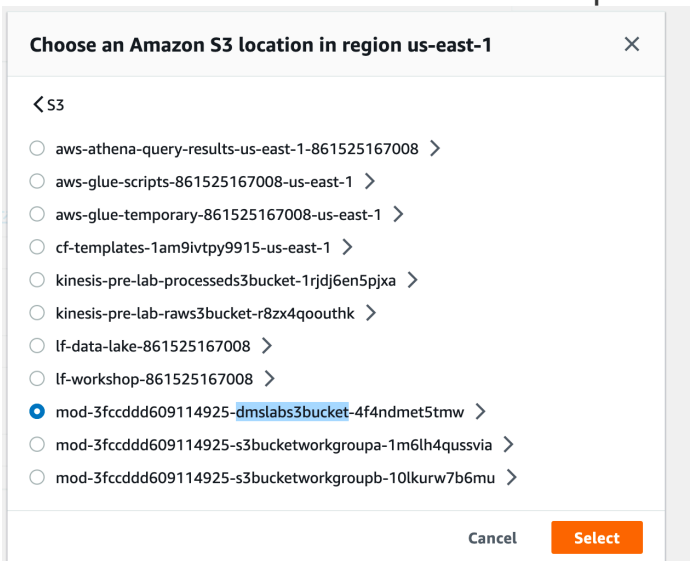
8. On the left pane navigate to **Blueprints** and click **Use blueprints**.



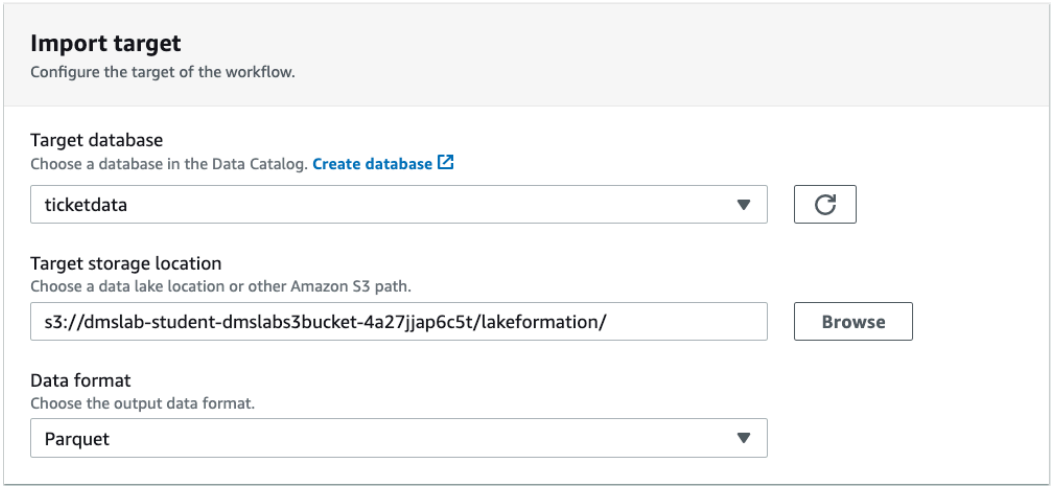
a. For **Blueprint Type**, select **Database snapshot**
b. Under Import Source
    i. For **Database Connection** choose **glue-rds-connection**
    ii. For **Source Data Path** enter **sportstickets/dms_sample/player**



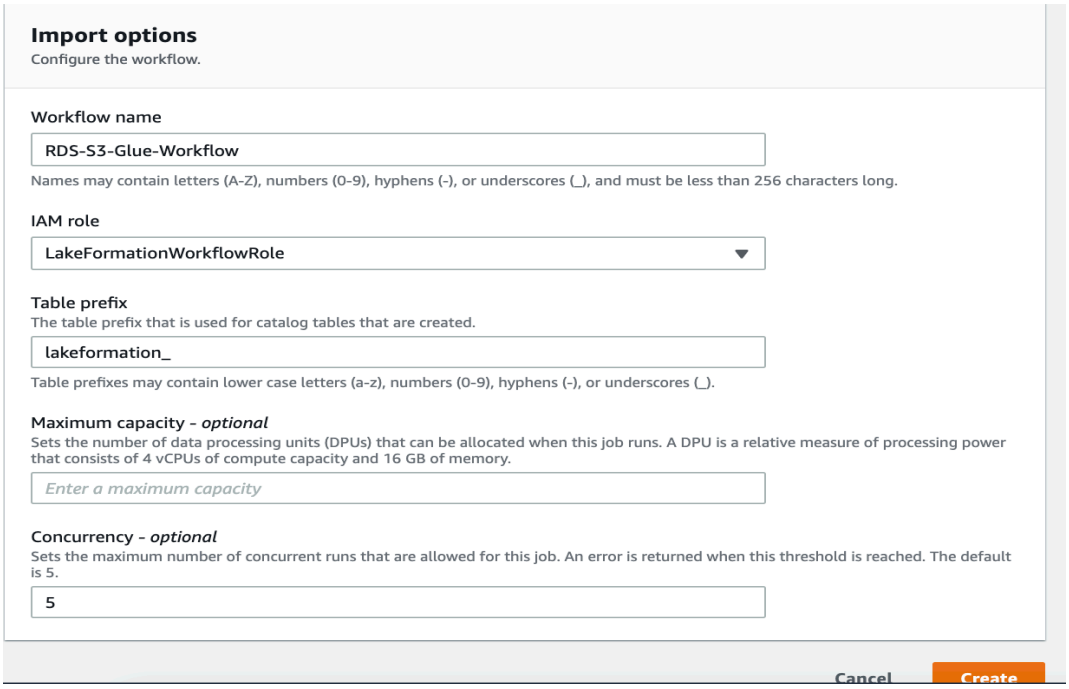
c. Under Import Target
   i. For **Target Database**, choose **ticketdata**
   ii. For **Target storage location** browse and select the **xxx-dmslabS3bucket-xxx** created in the previous lab.



   iii. Add **/lakeformation** at the end of the bucket url path, e.g. s3://mod-08b80667356c4f8a-dmslabs3bucket-nh54wqg771lk**/lakeformation**
   iv. For **Data Format** choose **Parquet**

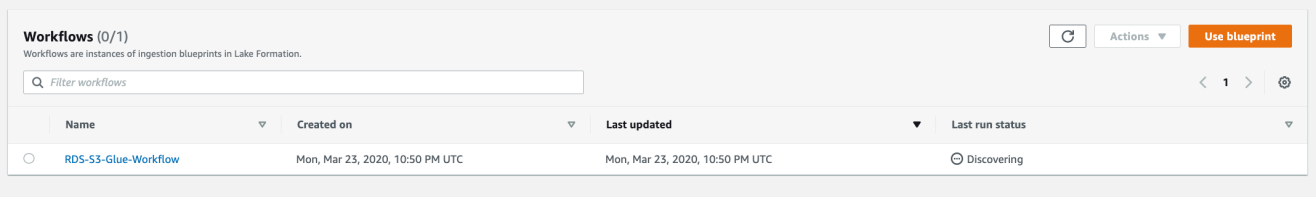


d. For **Import Frequency**, Select **Run On Demand**
e. For **Import Options**:
    i. Give a Workflow Name **RDS-S3-Glue-Workflow**
    ii. For the **IAM role** choose the precreated **...-LakeFormationWorkflowRole-...**
    iii. For **Table prefix** type **lakeformation**



9. Leave other options as default, click **Create**, and wait for the console to report that the workflow was successfully created.
10. Once the blueprint gets created, select it and click **Action -> Start.** There may be a delay of 5-10s delay in the blueprint showing up. You may have to **hit refresh**.

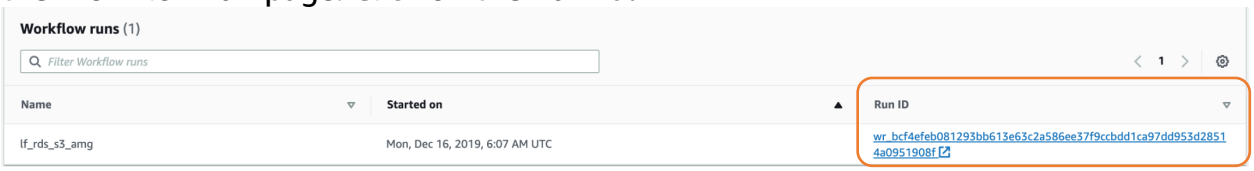
11. Once the workflow starts executing, you will see the status changes from running → discovering → Completed



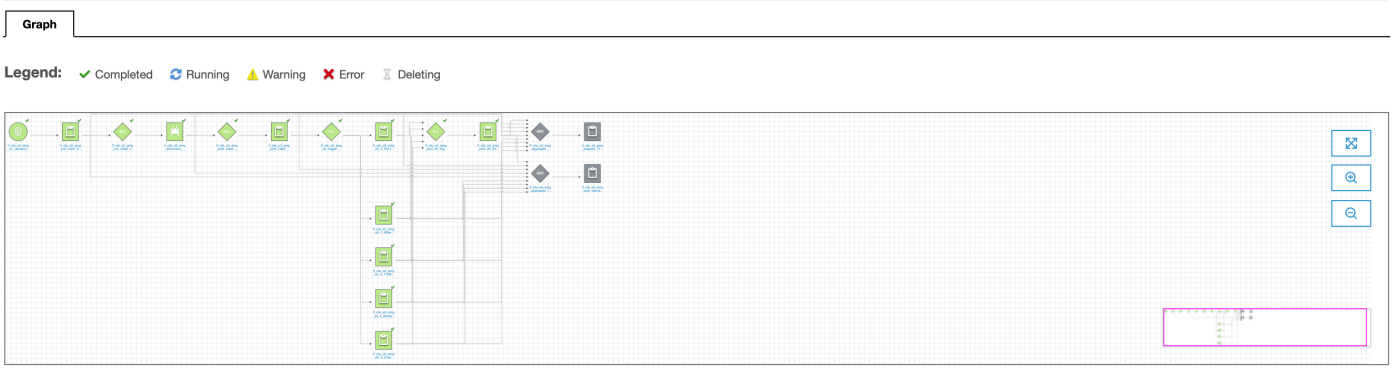
Explore the Underlying Components of a Blueprint

The Lake Formation blueprint creates a Glue Workflow under the hood which contains Glue ETL jobs – both python shell and pyspark, Glue crawlers and triggers. It will take somewhere between 15-20 mins to finish its first execution. In the meantime, let us drill down to see what it creates for us;

1. On the **Lake Formation console**, in the navigation pane, choose **Blueprints**
2. In the **Workflow section**, click on the **Workflow name**. This will direct you to the Workflow run page. Click on the **Run Id.**



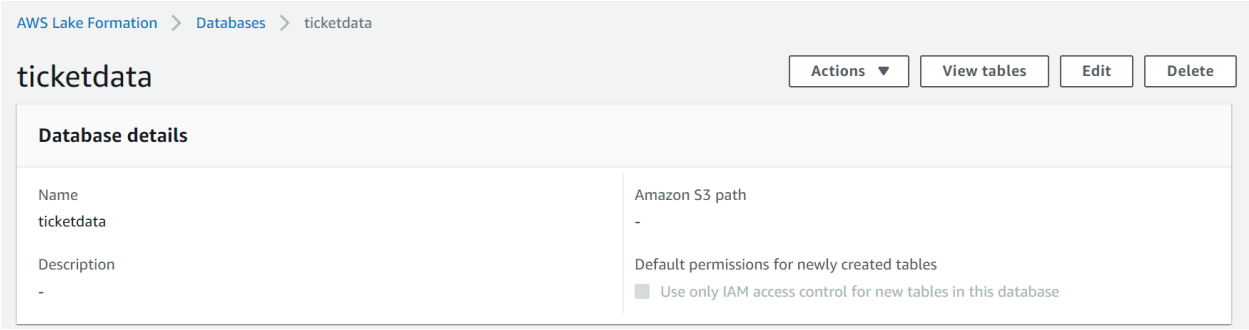
3. Here you can see the graphical representation of the Glue workflow built by Lake Formation blueprint. Highlighting and clicking on individual components will display the details of those components (name, description, job run id, start time, execution time)
4. To understand what all Glue Jobs got created as a part of this workflow, in the navigation pane, click on **Jobs**.
5. Every job comes with history, details, script and metrics tab. Review each of these tabs for any of the python shell or pyspark jobs.



Explore workflow results in Athena

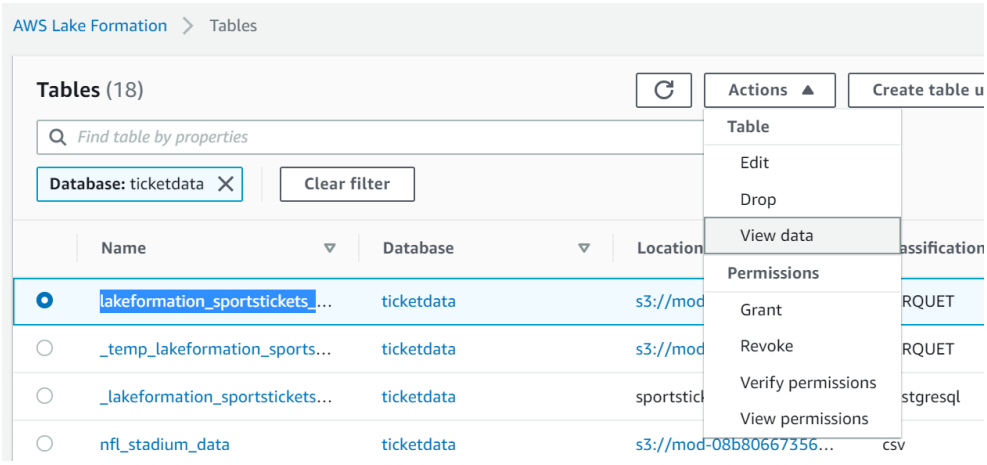
1. Navigate to the Lake Formation Console: https://console.aws.amazon.com/lakeformation/home?region=us-east-1#databases

2. Navigate to **Databases** on the left panel and select **ticketdata**
3. Click on **View tables**

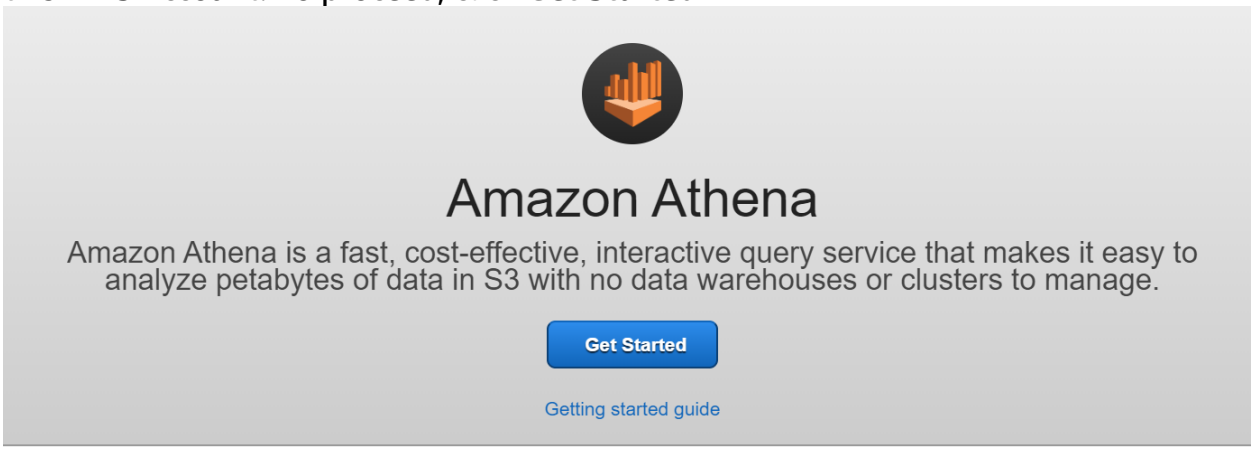


Select table **lakeformation_sportstickets_dms_sample_player**. As per our configuration above, Lake Formation tables were prefixed with **lakeformation_**

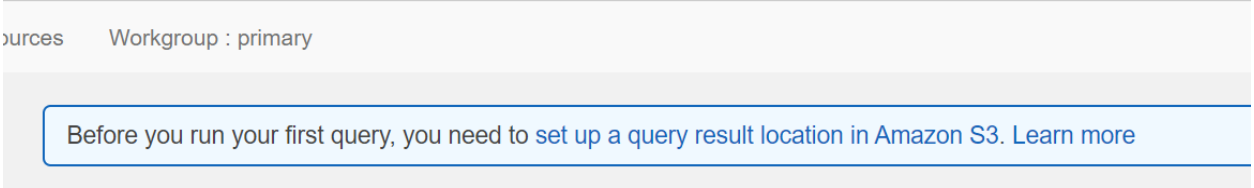
4. And Click **Action** -> **View Data**



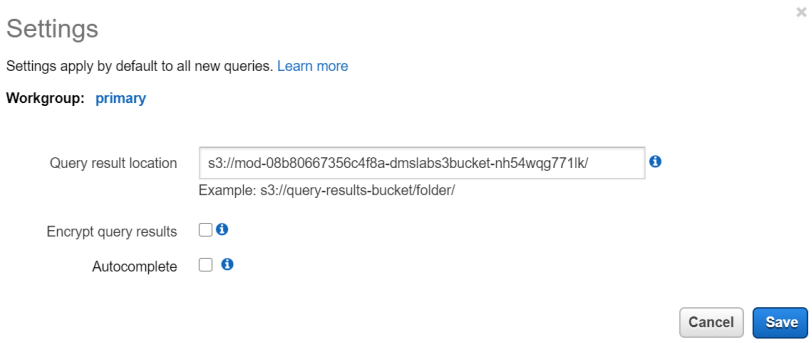
This will now take you to **Athena** console.
If you see a "Get Started" page, it's because it's the first time we're using Athena in this AWS Account. To proceed, click **Get Started**



Then click **set up a query result location in Amazon S3** at the top



In the pop-up window in the **Query result location** field, enter your s3 bucket location followed by /, so that it looks like **s3://xxx-dmslabs3bucket-xxx/** and click **Save**



To select some rows from the table, try running:

```
SELECT * FROM
"ticketdata"."lakeformation_sportstickets_dms_sample_player" limit
10;
```

To get a row count, run:

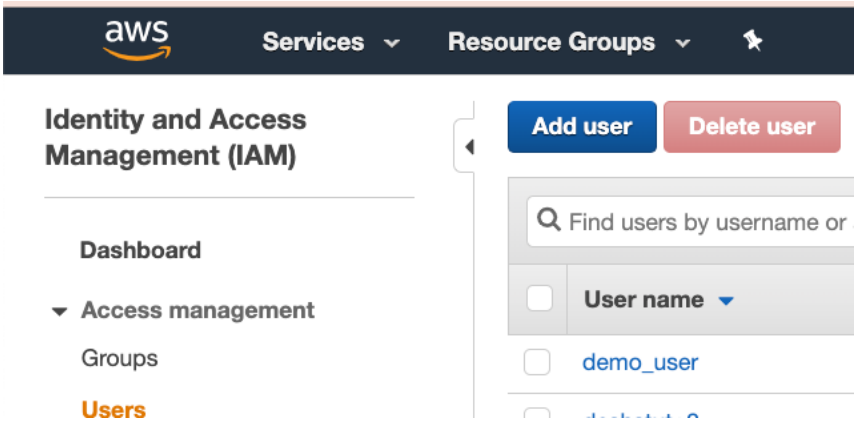
```
SELECT count(*) as recordcount FROM
"ticketdata"."lakeformation_sportstickets_dms_sample_player" limit
10;
```

Congratulation!!! You have completed lake formation lab. To explore more fine grain data lake security feature, continue to next section.

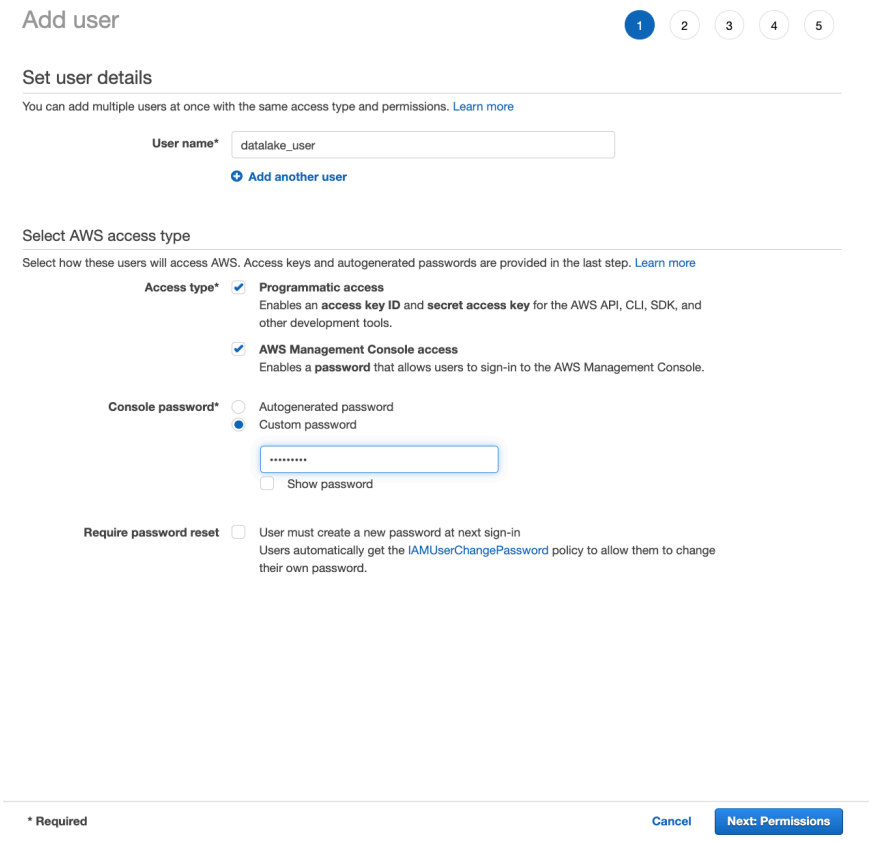
[Optional] Grant fine grain access controls to Data Lake user

Before we start the querying the data, let us create an IAM User **datalake_user** and grant column level access on the table created by the Lake formation workflow above, to **datalake_user.**

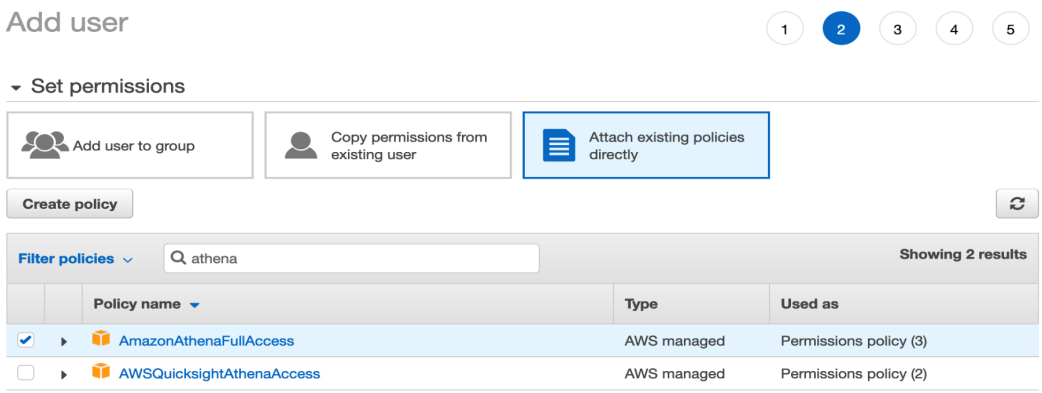
1. Login as admin user to your account. Navigate to **IAM Console**: https://console.aws.amazon.com/iam/home?region=us-east-1#/users and click on **Add User**.



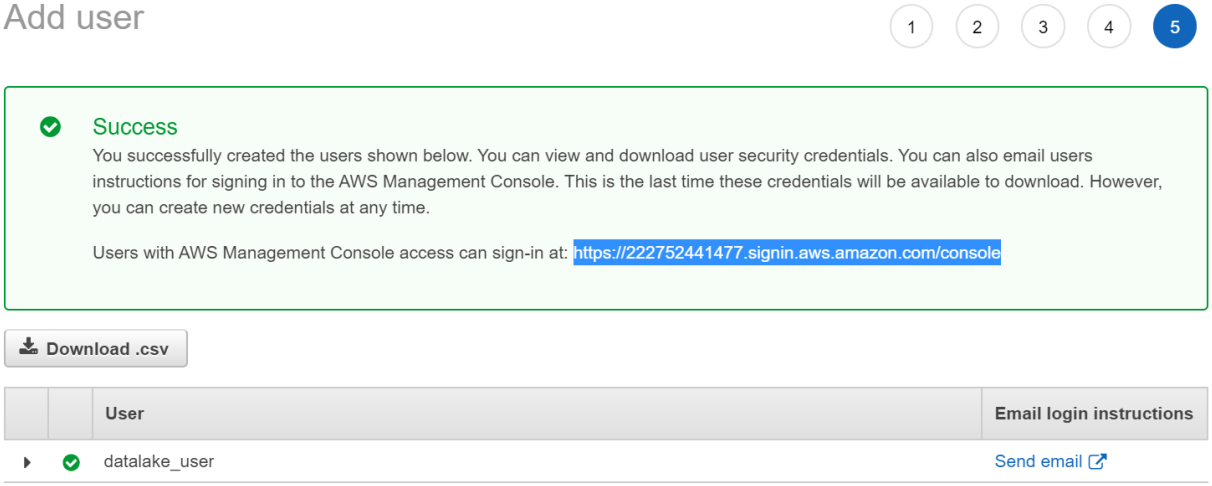
2. Create a user named **datalake_user** and give it a password: **master123**.



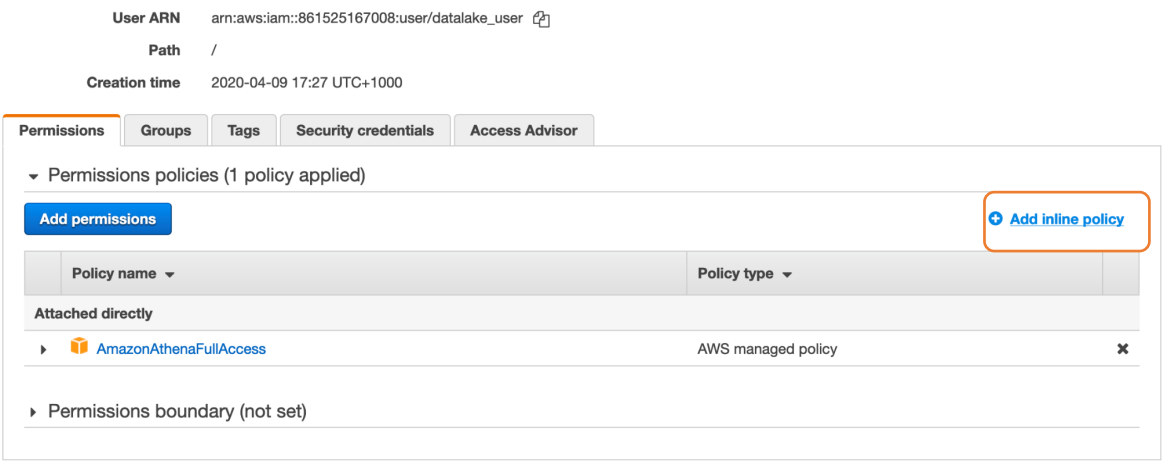
3. Next click on **Permissions**
4. Choose **Attach existing policies directly** and search for **AthenaFullAccess**



5. Keep navigating to the next steps until reached the end. Review the details and click on "**Create User**".
6. On the final screen, write down the sign-in link and hit **Close**



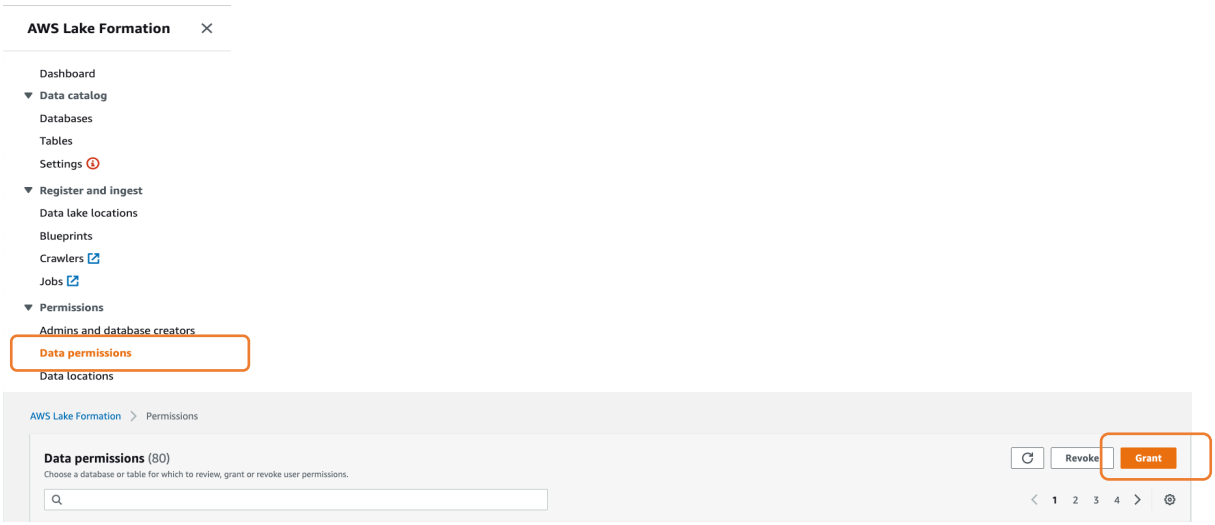
7. Click on the **datalake_user** user, and **add inline policy** and switch to the **JSON** tab



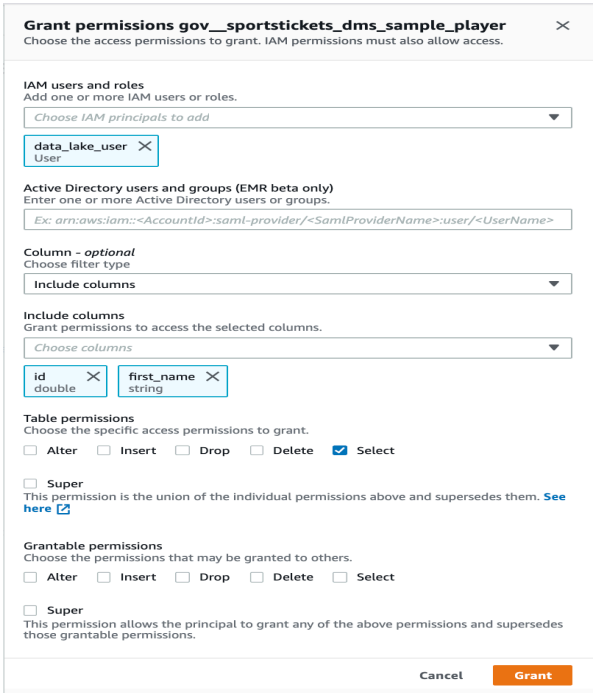
Use the following json snippet replacing <your_dmslabs3bucket_unique_name> with the name of your dmslabs3bucket, e.g. **mod-08b80667356c4f8a-dmslabs3bucket-nh54wqg771lk**

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
        "Effect": "Allow",
        "Action": [
        "s3:Put*",
        "s3:Get*",
        "s3:List*"
        ],
        "Resource": [
      "arn:aws:s3:::<your_dmslabs3bucket_unique_name>/*"
      ]
        }
    ]
}
```

8. Give a name **athena_access** to the policy, then **Create Policy**
9. Navigate to the **Lake Formation console:** https://console.aws.amazon.com/lakeformation/home?region=us-east-1#dashboard, in the navigation pane, under **Permissions**, choose **Data permissions**.



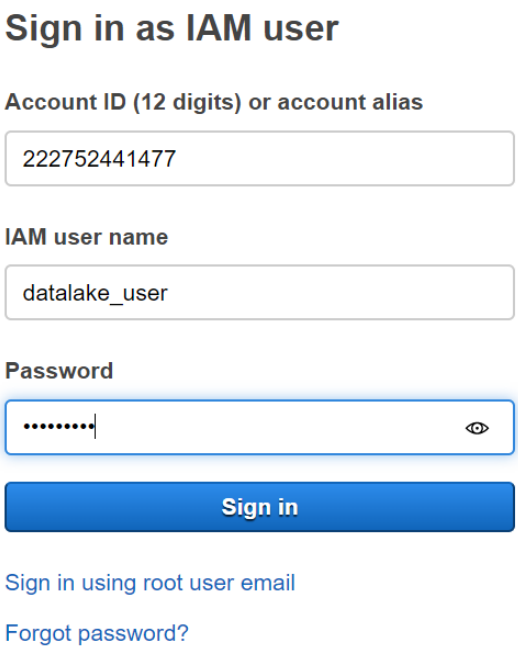
10. Choose **Grant**, and in the **Grant permissions** dialog box, do the following:
    a. For **IAM user and roles**, choose **datalake_user.**
    b. For **Database**, choose **ticketdata**
    c. The **Table** list populates.
    d. For **Table**, choose **lakeformation_sportstickets_dms_sample_player**.
    e. For Columns, select **Include Columns** and choose **id**, **first_name**
    f. For **Table permissions**, untick **Super** and choose **Select**.
11. Choose **Grant**.



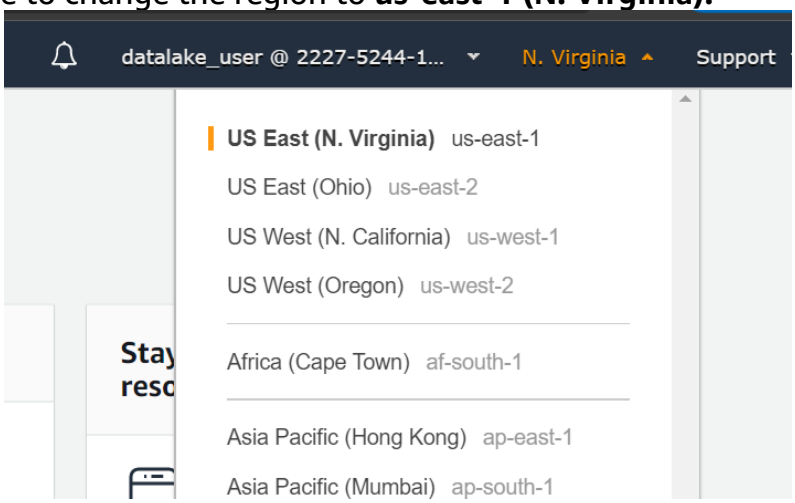
[Optional] Verify data permissions using Athena

Using Athena, let us now explore the data set as the **datalake_user**.

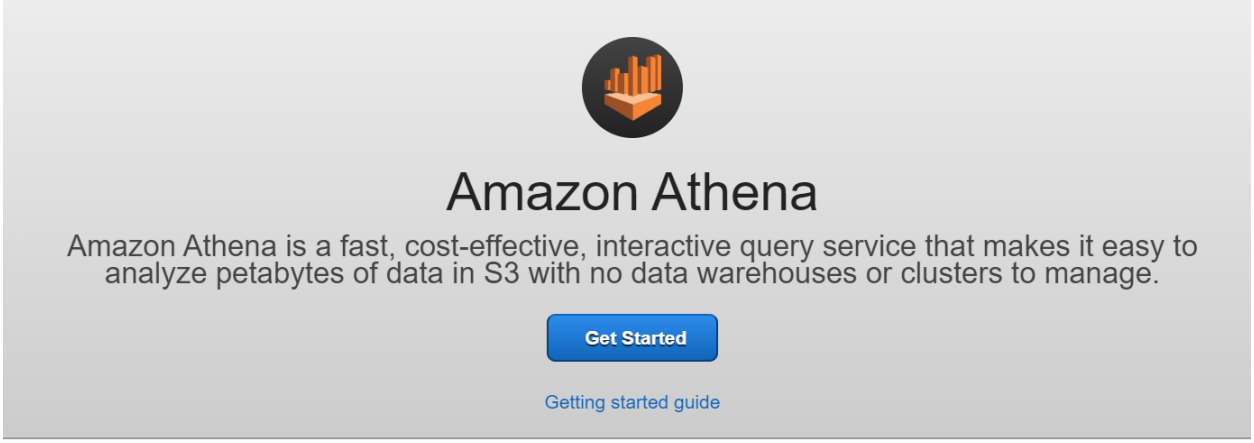
1. In a new incognito browser window, navigate to the sign-in URL you wrote down earlier when you created an IAM User. Sign in as **datalake_user** using **master123** as password



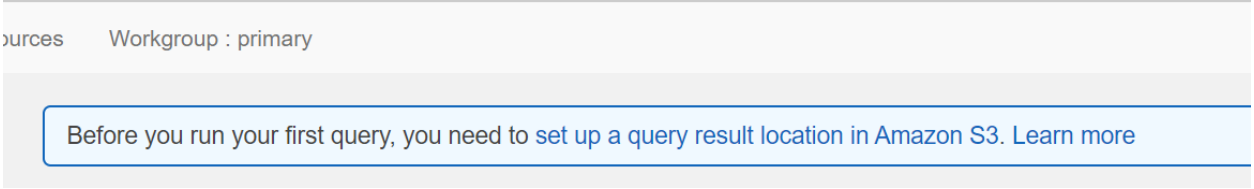
2. Make sure to change the region to **us-east-1 (N. Virginia):**



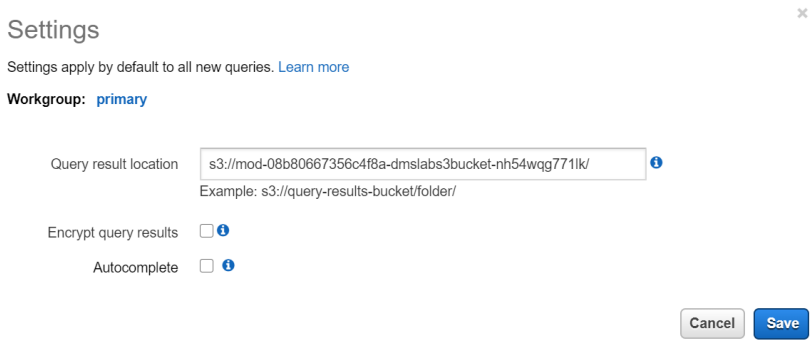
3. Navigate to the **Athena console (Services -> Athena).** If you see a “Get Started” page, it’s because it’s the first time we’re using Athena in this AWS Account. To proceed, click Get Started



Then click **set up a query result location in Amazon S3** at the top



In the pop-up window in the **Query result location** field, enter your s3 bucket location followed by **/**, so that it looks like **s3://xxx-dmslabs3bucket-xxx/** and click **Save**



4. Next, ensure database **ticketdata** is selected.
5. Now run a **Select** query on the **lakeformation_sportstickets_dms_sample_player** table within the **ticketdata** database:

```
SELECT * FROM
"ticketdata"."lakeformation_sportstickets_dms_sample_player"
limit 10;
```

6. You will notice that the **datalake_user** can **only see the columns id, first_name** in the select query result. The datalake_user cannot see **last_name**, **sports_team_id**, **full_name** columns in the table**.**