Amazon Web Services
Data Engineering Immersion Day

Extract, Transform and Load Data Lake with Glue

March 2020

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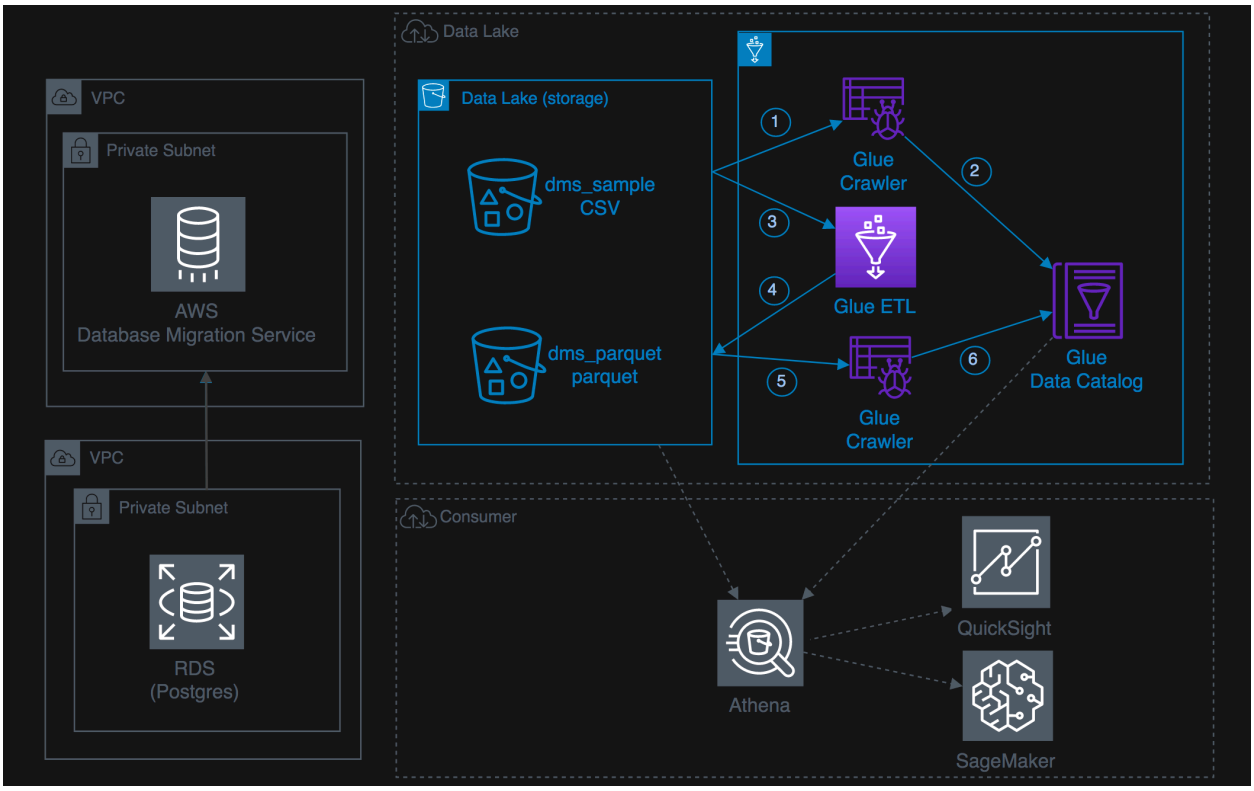
Introduction

This lab will give you an understanding of the AWS Glue – a fully managed data catalog and ETL service



Prerequisites:

The DMS Lab is a prerequisite for this lab.

Tasks Completed in this Lab:

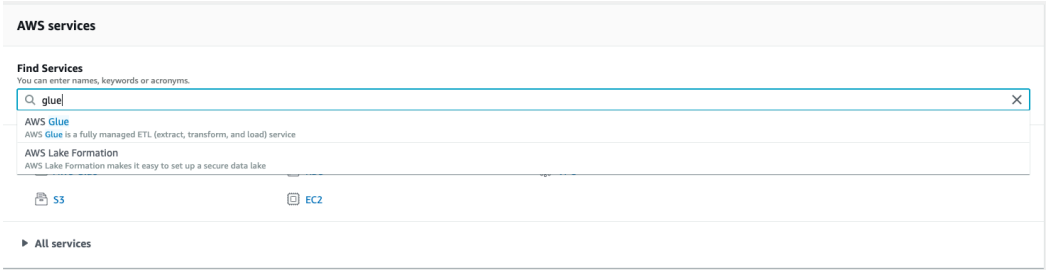
In this lab you will be completing the following tasks. You can choose to complete only Part-(A) to move to next lab where tables can be queried using Amazon Athena and Visualize with Amazon Quciksight

1. PART-(A): Data Validation and ETL
    a. Create Glue crawler for initial full load data
    b. Create Glue ETL to transform CSV data to Parquet format
    c. Create Glue crawler to crawl Parquet Data to build Data Catalog
2. PART- (B): Glue Job Bookmark Functionality(Optional)
    a. Create Glue crawler for ongoing replication
    b. Create Glue Job with Bookmark enabled

Labs are also available in GitHub - https://github.com/aws-samples/data-engineering-for-aws-immersion-day

Getting Started

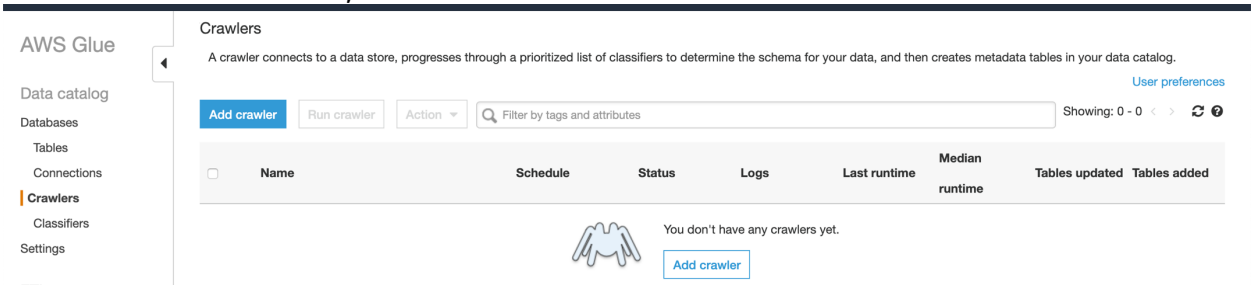
Navigate to the AWS Glue service.



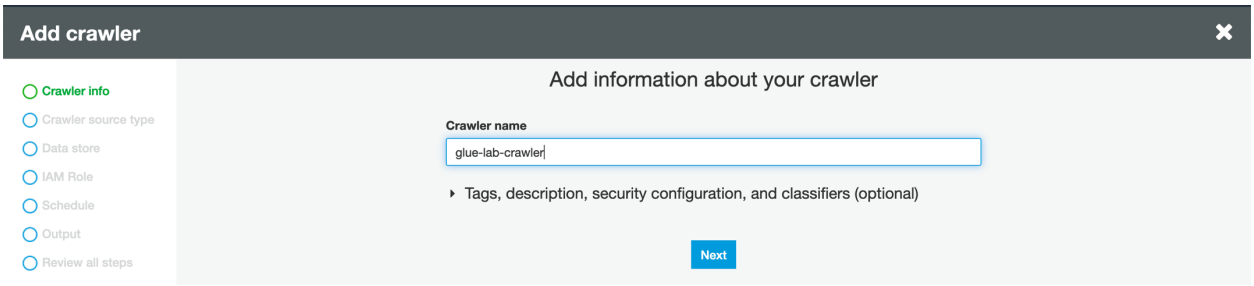
PART-(A): Data Validation and ETL

Create Glue Crawler for initial full load data

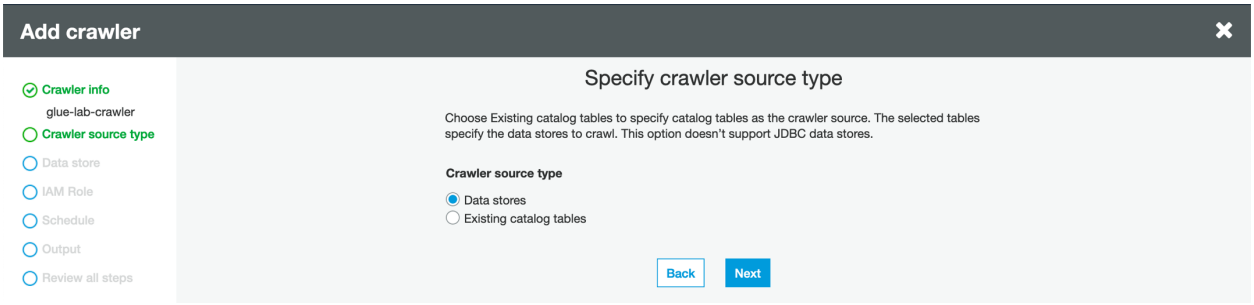
1. On the AWS Glue menu, select **Crawlers**.



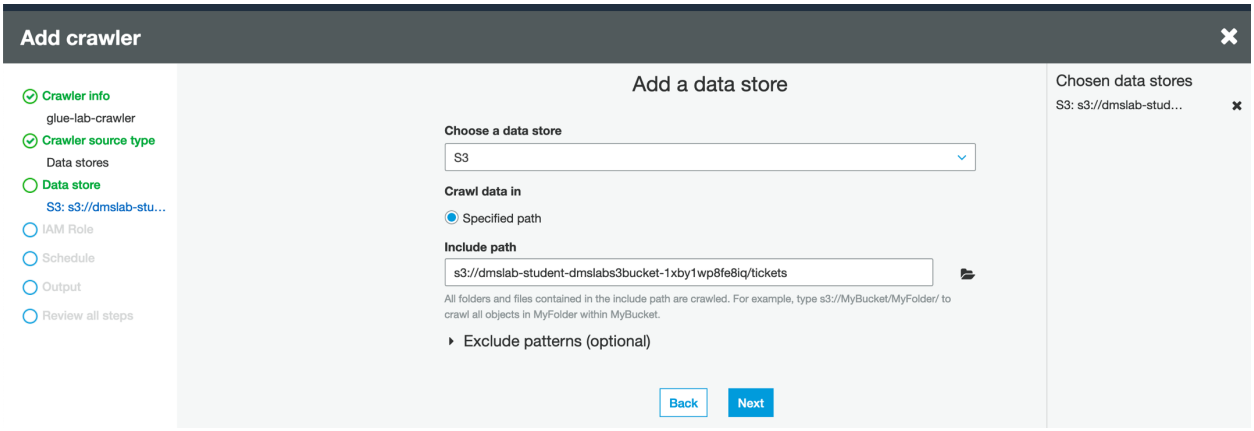
2. Click **Add crawler**.
3. Enter the crawler name for initial data load. This name should be descriptive and easily recognized (e.g ," glue-lab-crawler").
4. Optionally, enter the description. This should also be descriptive and easily recognized and Click **Next**.



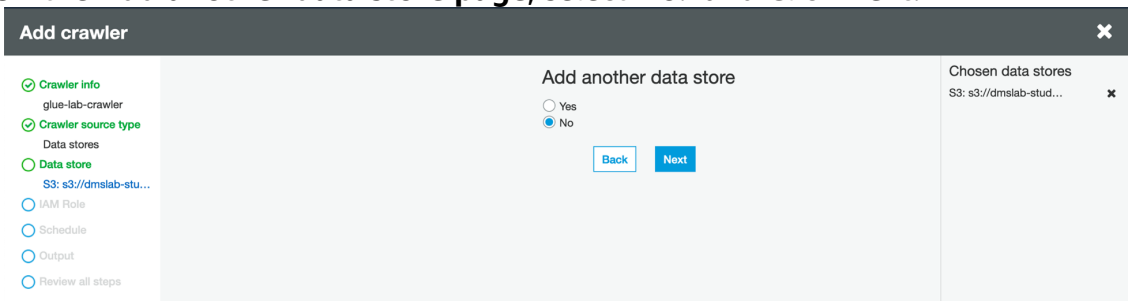
5. Choose **Crawler Source Type** as **Data Source** and **Click Next**



6. On the **Add a data store** page, make the following selections:
   a. For Choose a data store, click the drop-down box and select **S3**.
   b. For Crawl data in, select **Specified path in my account**.
   c. For Include path, browse to the target folder for your DMS initial export, e.g., “s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/tickets
7. Click **Next**.

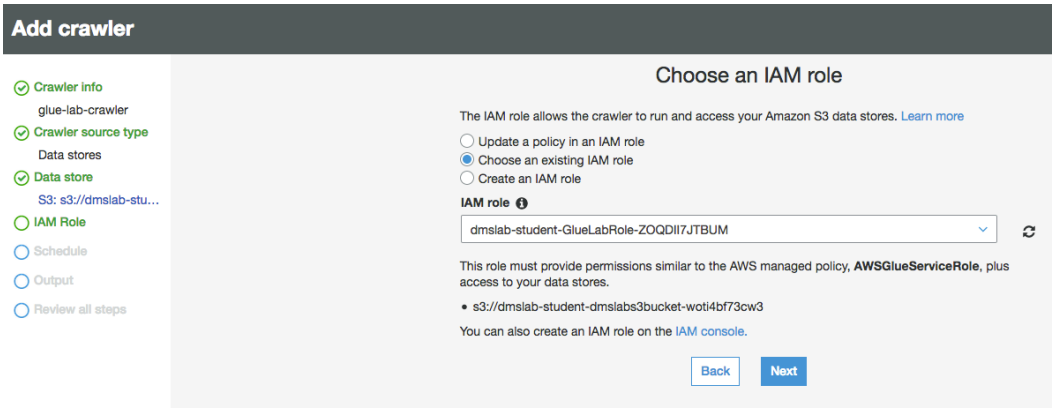


8. On the **Add another data store page**, select **No**. and Click **Next**.

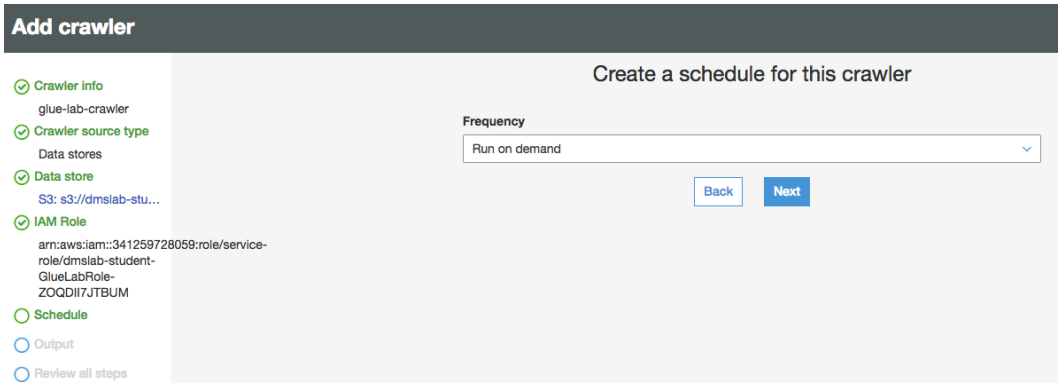


9. On the **Choose an IAM role** page, make the following selections:
    a. Select **Choose an existing IAM role**.
    b. **For IAM role**, select **<stackname>-GlueLabRole-<RandomString>** created from the AWS CloudFormation template during the student lab. For example “dmslab-student-GlueLabRole-ZOQDII7JTBUM”

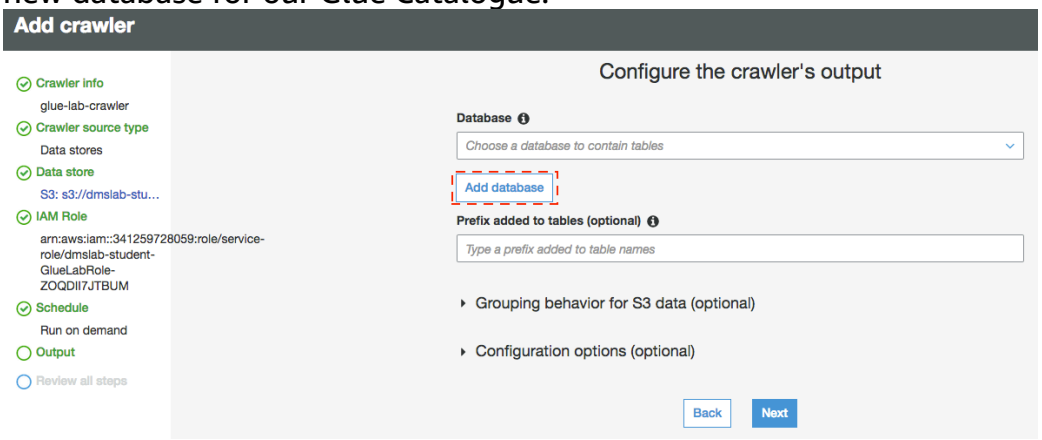
10. Click **Next**.



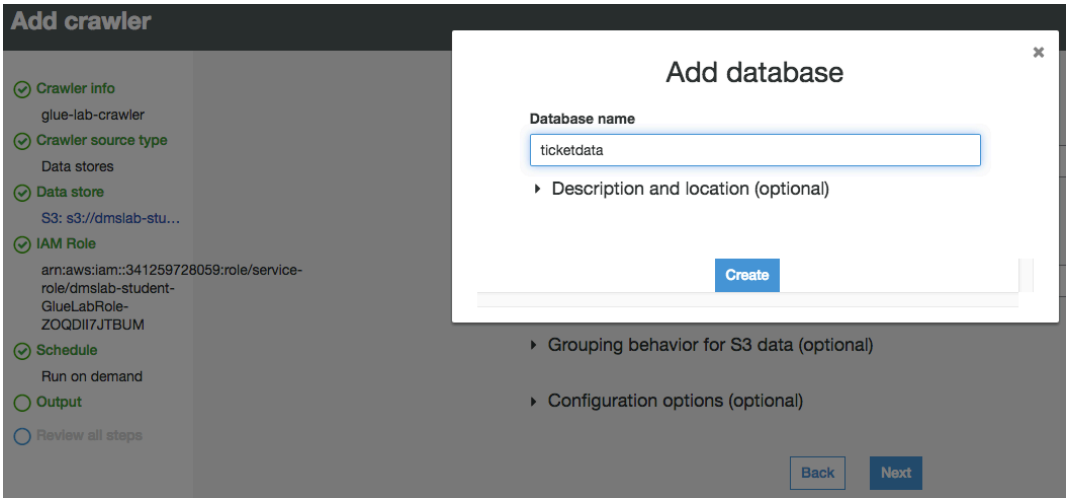
11. On the Create a schedule for this crawler page, for Frequency, select **Run on demand** and Click **Next**.



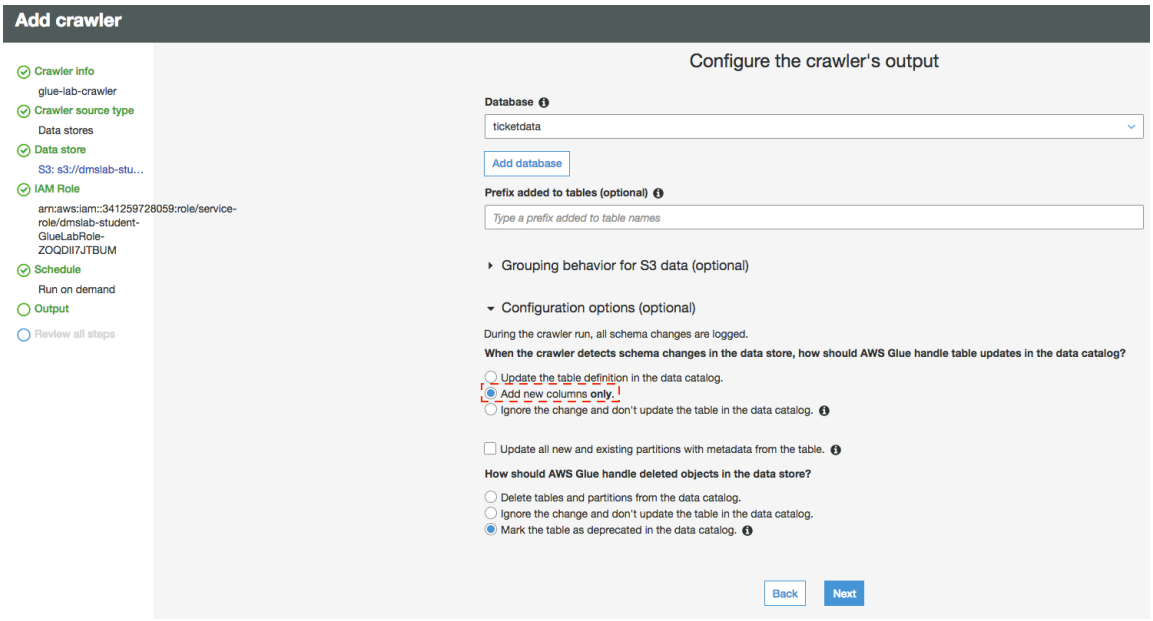
12. On the Configure the crawler’s output page, click **Add database** to create a new database for our Glue Catalogue.



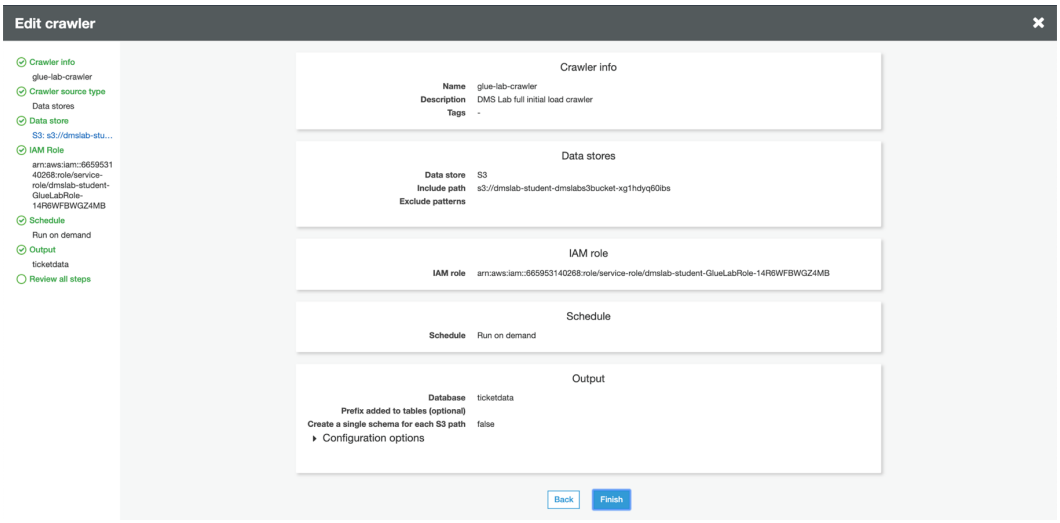
13. Give Catalog database name as per your convenient choice for example “ticketdata” and click **create**



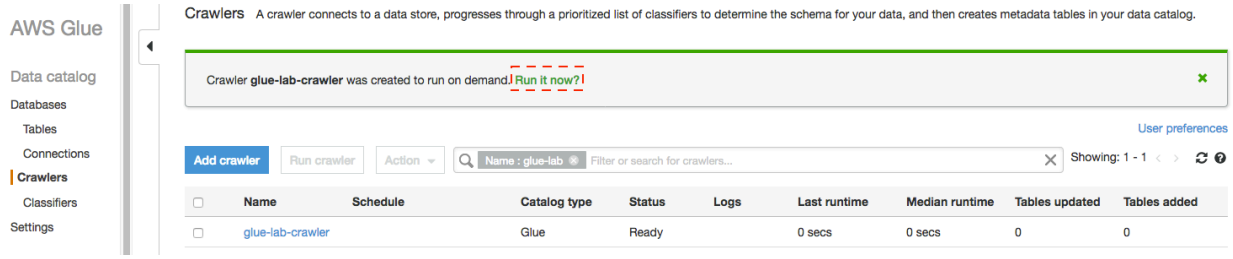
14. For Prefix added to tables (optional), leave the field empty.
15. For Configuration options (optional), select **Add new columns only** and keep the remaining default configuration options and Click **Next**.



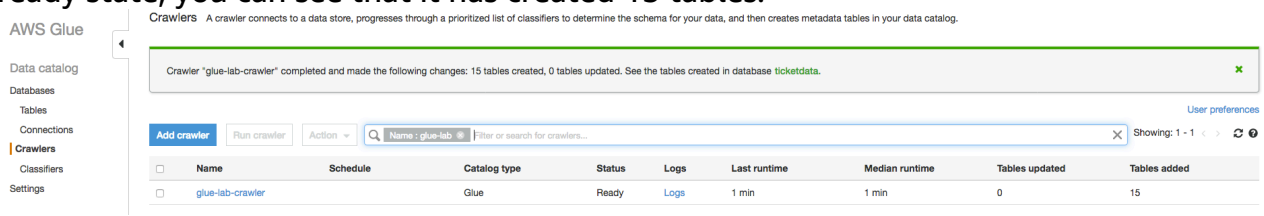
16. Review the summary page noting the Include path and Database output and Click **Finish**. The crawler is now ready to run.



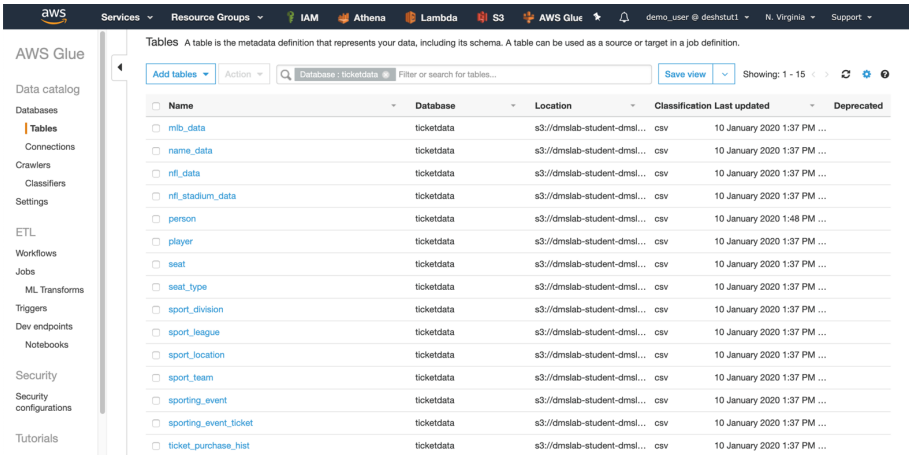
17. Click **Run it now**.



Crawler will change status from starting to stopping, wait until crawler comes back to ready state, you can see that it has created 15 tables.

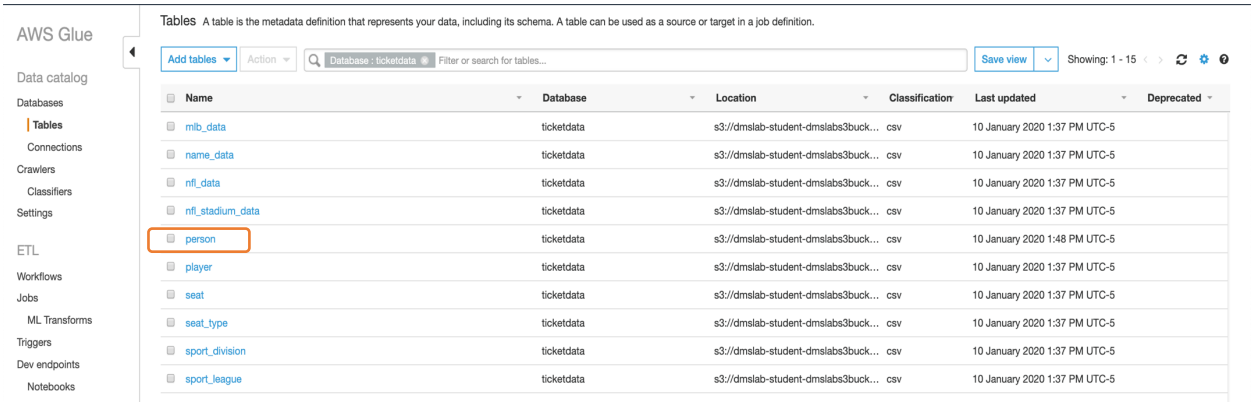


18. In the AWS Glue navigation pane, click **Databases** > **Tables**. (You can also click the database name (e.g., "ticketdata" to browse the tables.).



Data Validation Exercise

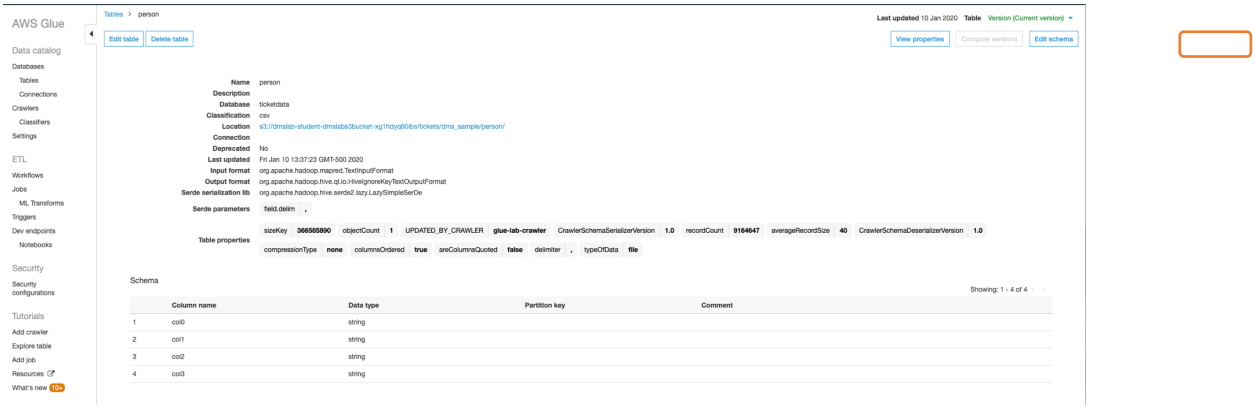
1. Within the Tables section of your ticketdata database, click the person table.



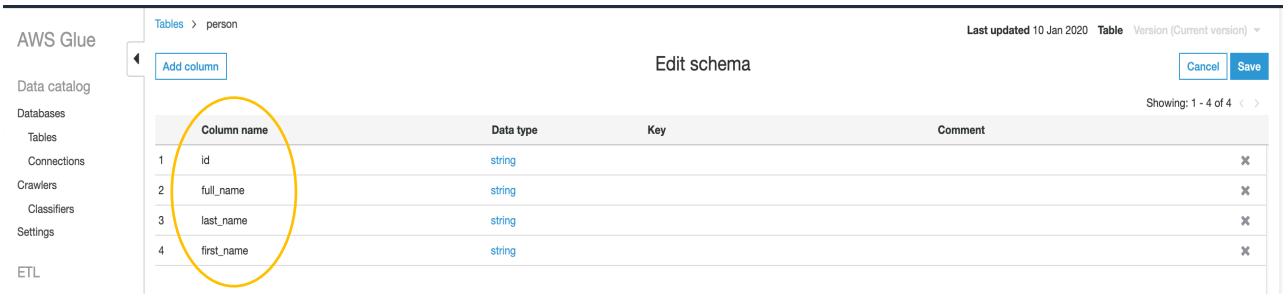
You may have noticed that some tables (such as person) have column headers such as col0,col1,col2,col3. In absence of headers or when the crawler cannot determine the header type, default column headers are specified.

This exercise uses the person table in an example of how to resolve this issue.

2. Click **Edit Schema** on the top right side.



3. In the Edit Schema section, double-click **col0** (column name) to open edit mode. Type “id” as the column name.
4. Repeat the preceding step to change the remaining column names to match those shown in the following figure.

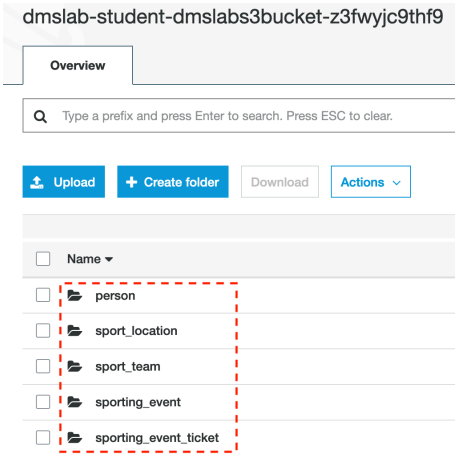


5. Click **Save**.

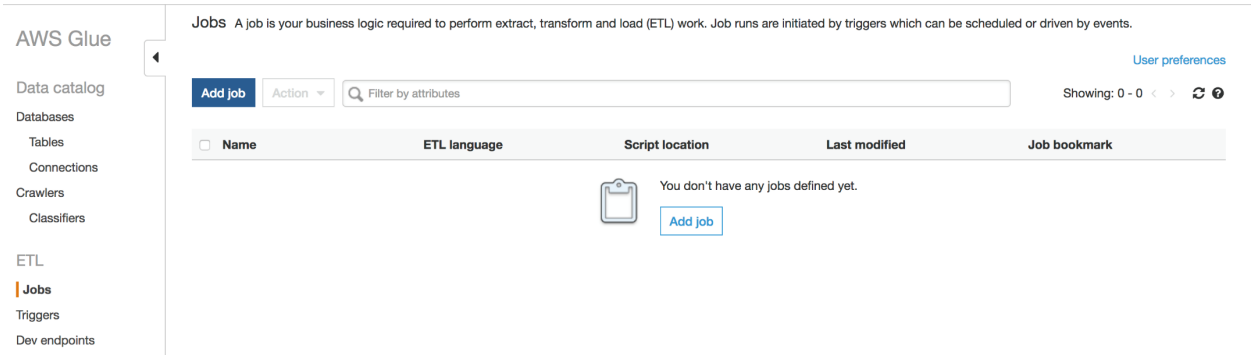
Data ETL Exercise

Pre-requisite: To store processed data you need new location. Please Follow this user guide to create folder following structure in your S3 bucket to store parquet file - https://docs.aws.amazon.com/AmazonS3/latest/user-guide/create-folder.html .

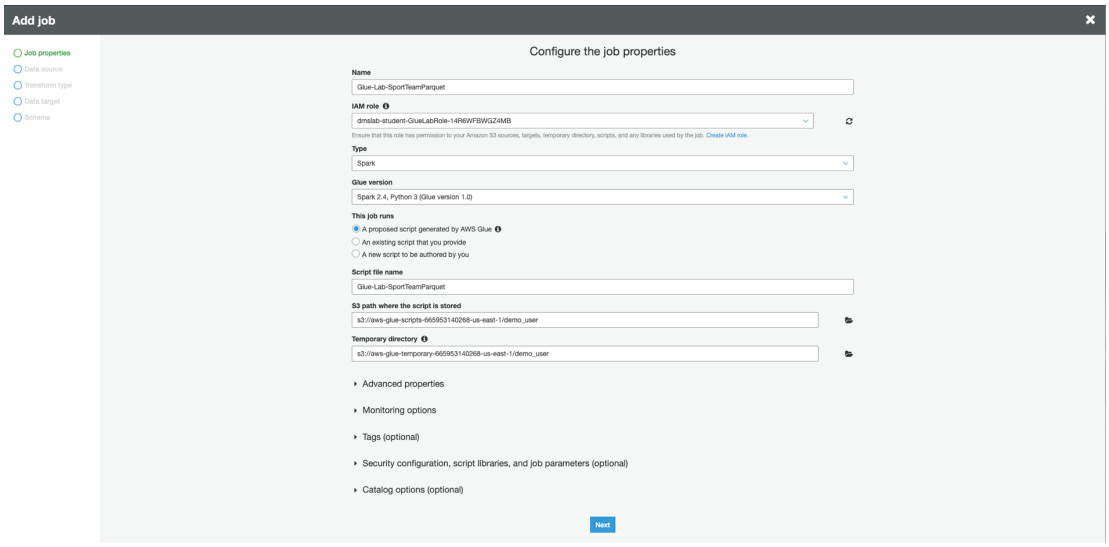
Full path will look like e.g. – "s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/tickets/dms_parquet/sport_team"



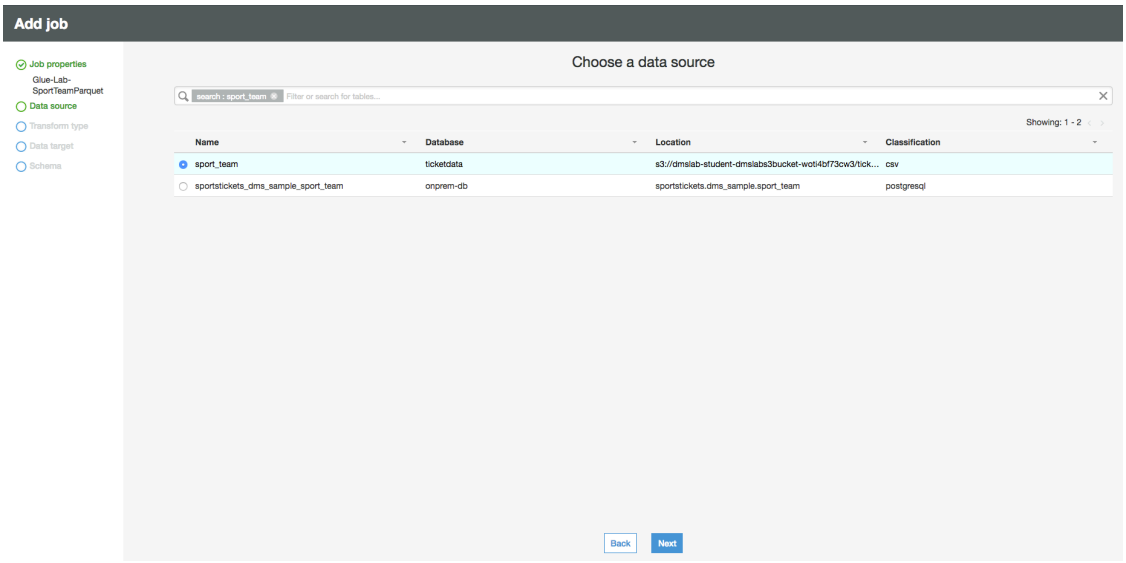
1. In the left navigation pane, under **ETL**, click **Jobs**, and then click **Add job**.



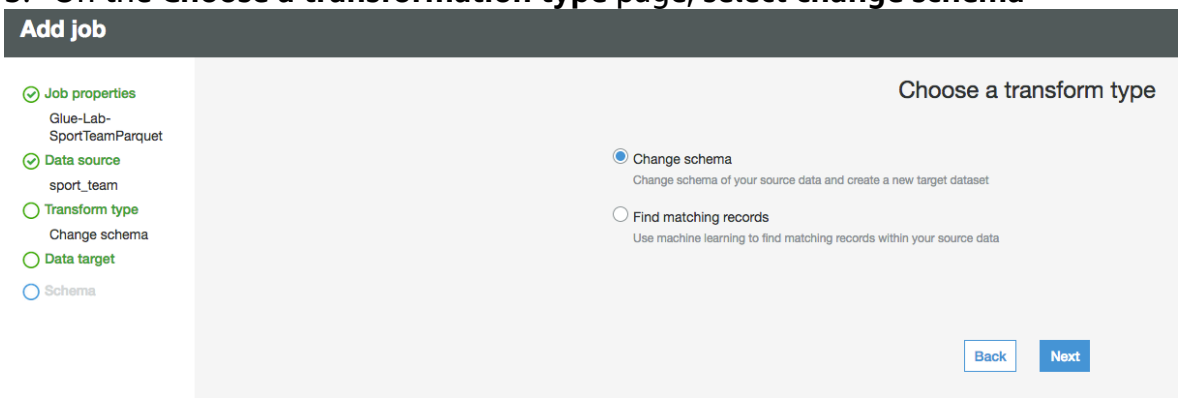
2. On the Job properties page, make the following selections:
    a. For **Name**, type “Glue-Lab-SportTeamParquet”
    b. For **IAM role**, choose existing role e.g. “dmslab-student-GlueLabRole-ZOQDII7JTBUM”
    c. For **Type**, Select “Spark”
    d. For **Glue Version**, select “Spark 2.4, Python 3(Glue version 1.0) “ or whichever is the latest version.
    e. For **This job runs**, select “A proposed script generated by AWS Glue”.
    f. For **Script file name**, type **Glue-Lab-SportTeamParquet**.
    g. For **S3 path where the script is stored**, provide a unique Amazon S3 path to store the scripts. (You can keep the default for this lab.)
    h. For **Temporary directory**, provide a unique Amazon S3 directory for a temporary directory. (You can keep the default for this lab.)



3. Click **Next**
4. On the Choose your data sources page, select **sport_team** and Click **Next**.

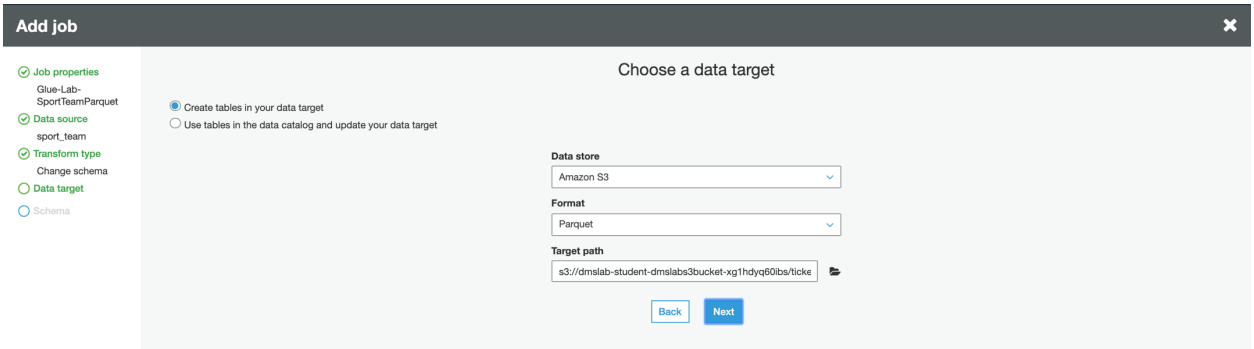


5. On the **Choose a transformation type** page, select **change schema**

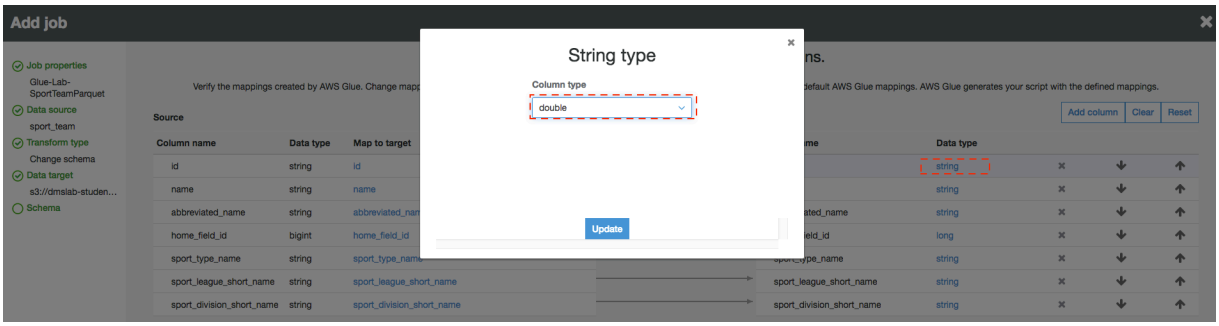


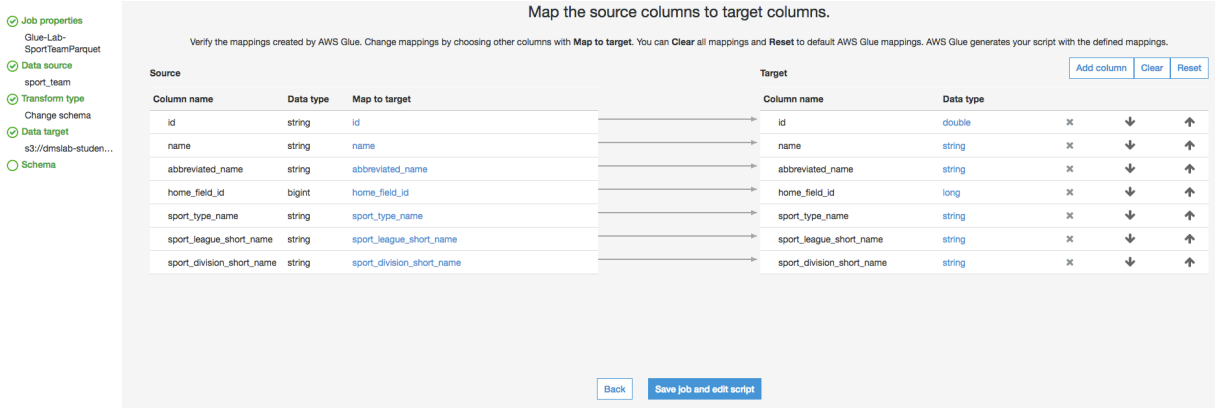
6. On the Choose your data targets page, select **Create tables in your data target**.
7. For Data store, select **Amazon S3**.
8. For Format, select **Parquet**.
9. For **Target path,** choose a folder location which you create at the beginning of this section to store the results e.g., " s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/tickets/dms_parquet/sport_team"

10. Click **Next**.



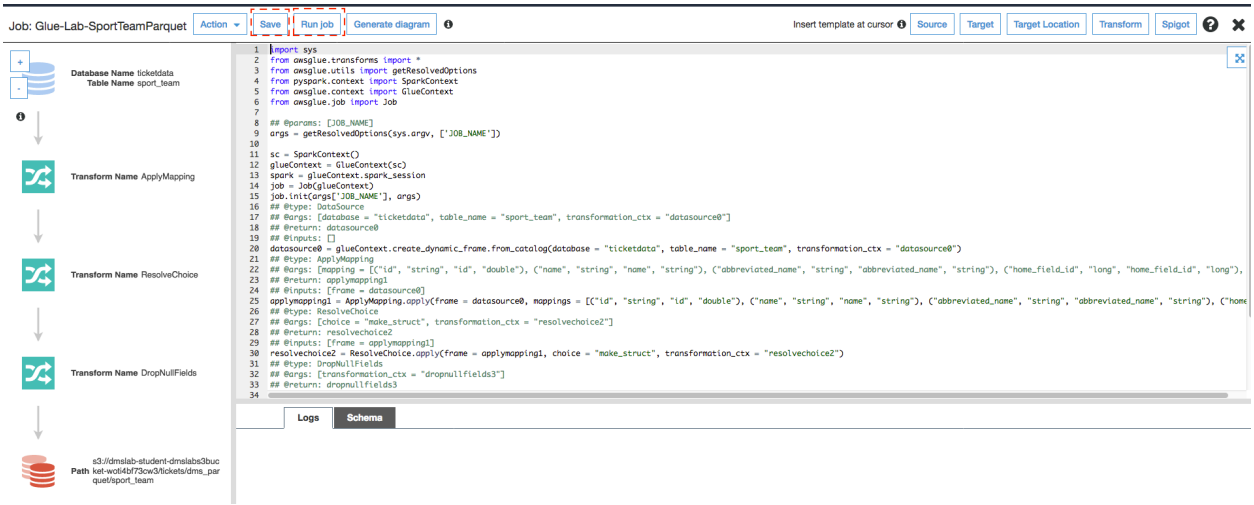
11. Click the target **Data type** to edit the id schema mapping. In **String type** pop-up window Select **double** from **Column type** drop down and click **update**.





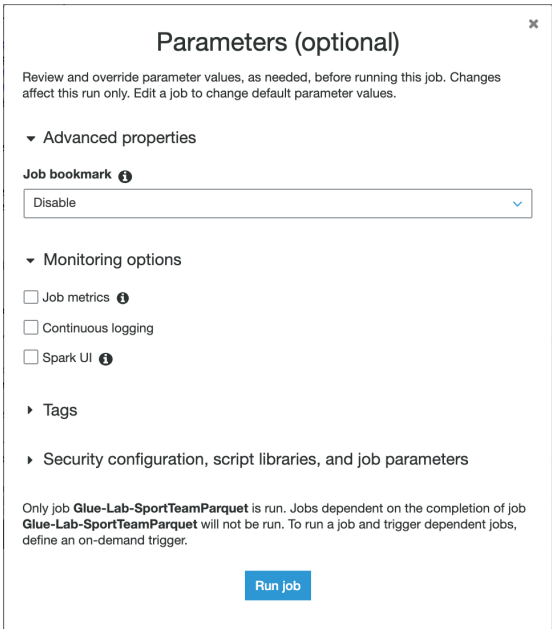
12. Click **Save job** and **edit script**.

13. View the job. (This screen provides you with the ability to customize this script as required.) Click **Save** and then **Run Job**.

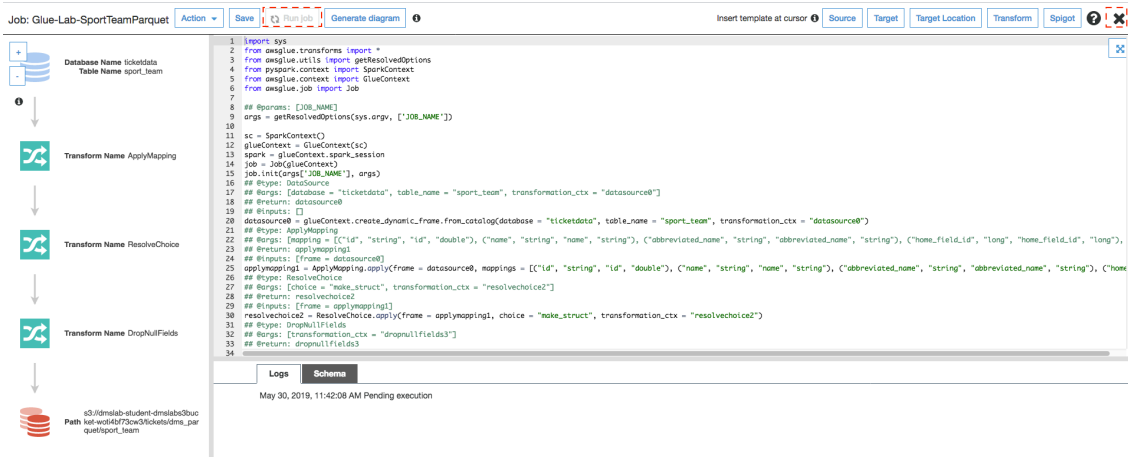


14. In **Parameters** option,

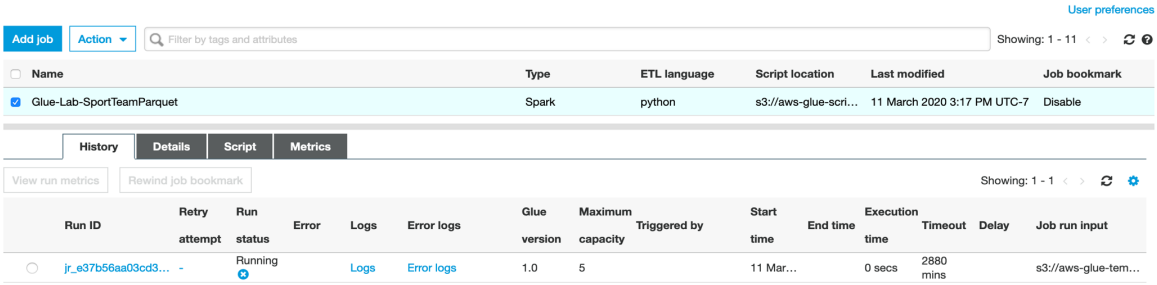
a. you can leave **Job bookmark** as **Disable**. AWS Glue tracks data that has already been processed during a previous run of an ETL job by persisting state information from the job run.
b. You can leave the **Job metrics** option **Unchecked**. You can collect metrics about AWS Glue jobs and visualize them on the AWS Glue with job metrics.



15. Click **Run Job**
16. You will see job in now running as **Run job** button got disable. Click the cross button located in top right corner to close the window to return to the ETL jobs.



17. Click your job to view history and verify that it ran successfully.



You need to repeat the preceding steps to create new ETL Jobs to transform the additional tables. You will use transform data in next Athena lab. You can continue creating below ETL job without waiting for previous job to finish.

To enable us to join data, we will also update the target data types in the schema. If below **Table1** is indicating need Schema changes as "Yes". Refer **Table 2** find out column which need to changes with source and target data type during ETL job creation.

Table 1:

Job Name & Script Filename	Source Table	S3 Target Path	Need Schema Change?
Glue-Lab-SportLocationParquet	sport_location	dms_parquet/sport_location	No
Glue-Lab-SportingEventParquet	sporting_event	dms_parquet/sporting_event	Yes
Glue-Lab-SportingEventTicketParquet	sporting_event_ticket	dms_parquet/sporting_event_ticket	Yes
Glue-Lab-PersonParquet	person	dms_parquet/person	Yes

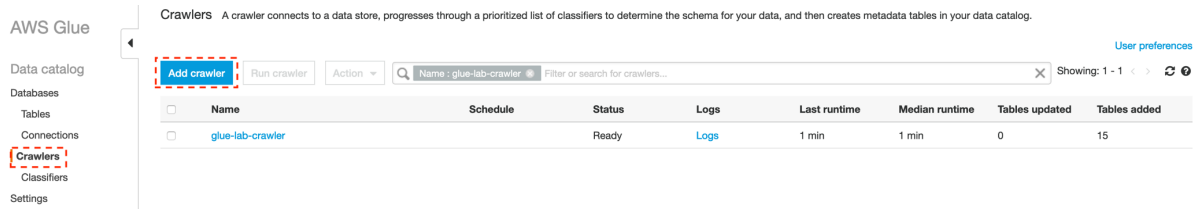
Table 2:

Job Name	Table	Column	Source Data Type	Target Data Type
Glue-Lab-SportingEventParquet	sporting_event	start_date_time	STRING	TIMESTAMP
Glue-Lab-SportingEventParquet	sporting_event	start_date	STRING	DATE
Glue-Lab-SportingEventTicketParquet	sporting_event_ticket	id	STRING	DOUBLE
Glue-Lab-SportingEventTicketParquet	sporting_event_ticket	sporting_event_id	STRING	DOUBLE
Glue-Lab-SportingEventTicketParquet	sporting_event_ticket	ticketholder_id	STRING	DOUBLE
Glue-Lab-PersonParquet	person	id	STRING	DOUBLE

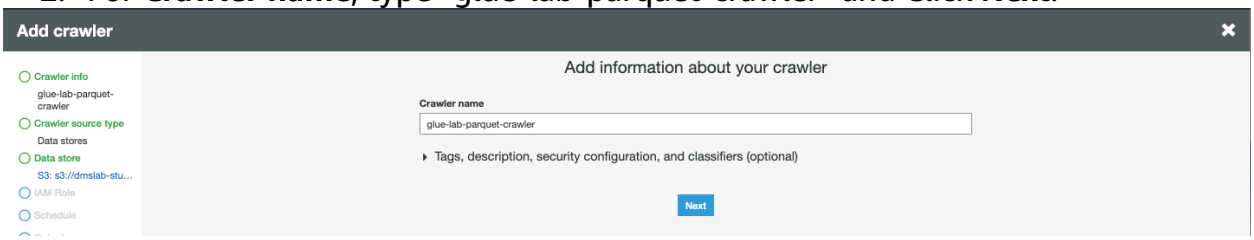
Once these jobs have completed, we can create a crawler to index these parquet files.

Create Glue Crawler for Parquet Files

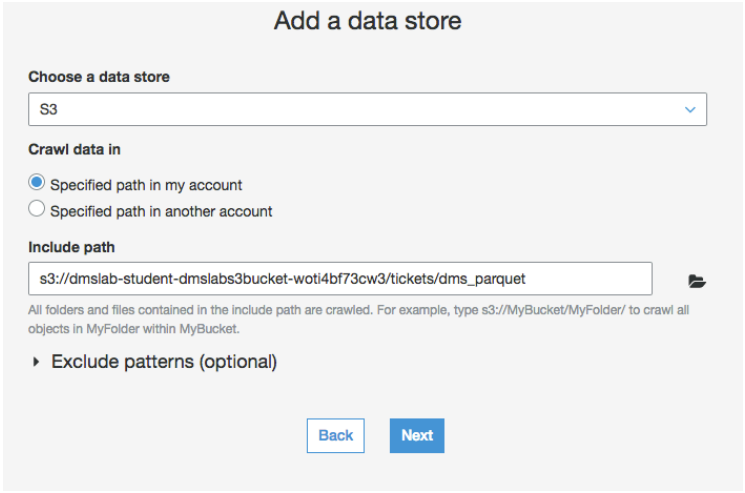
1. In the AWS Glue navigation menu, click **Crawlers**, and then click **Add crawler**.



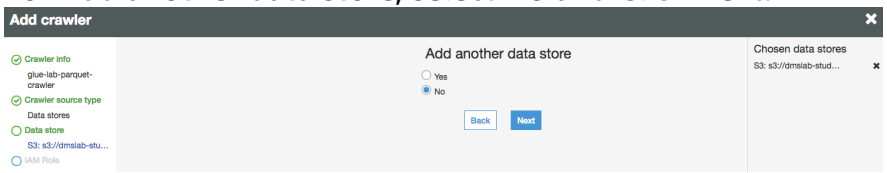
2. For **Crawler name**, type “glue-lab-parquet-crawler” and Click **Next**.



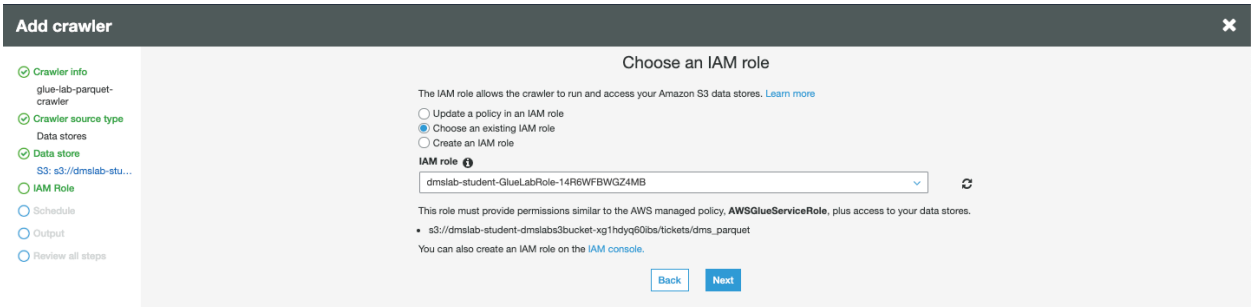
3. In next screen **Specify crawler source type,** select **Data Source** as choice **for Crawler resource type** and click **Next.**
4. In Add a data store screen
    a. For **Choose a data store**, select “S3”.
    b. For **Crawl data** in, select “Specified path in account”.
    c. For Include path, specify the S3 Path (Parent Parquet folder) that contains the nested parquet files e.g., s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/tickets/dms_parquet
    d. Click **Next**.



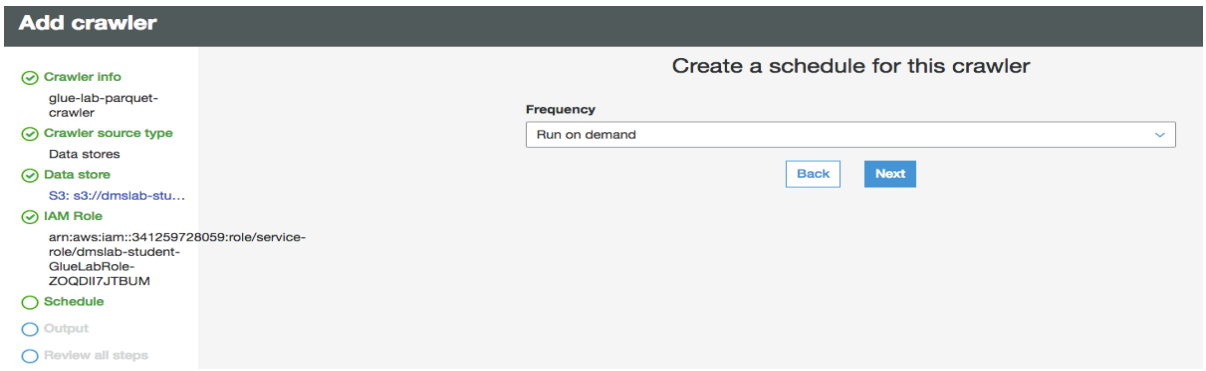
5. For Add another data store, select **No** and Click **Next**.



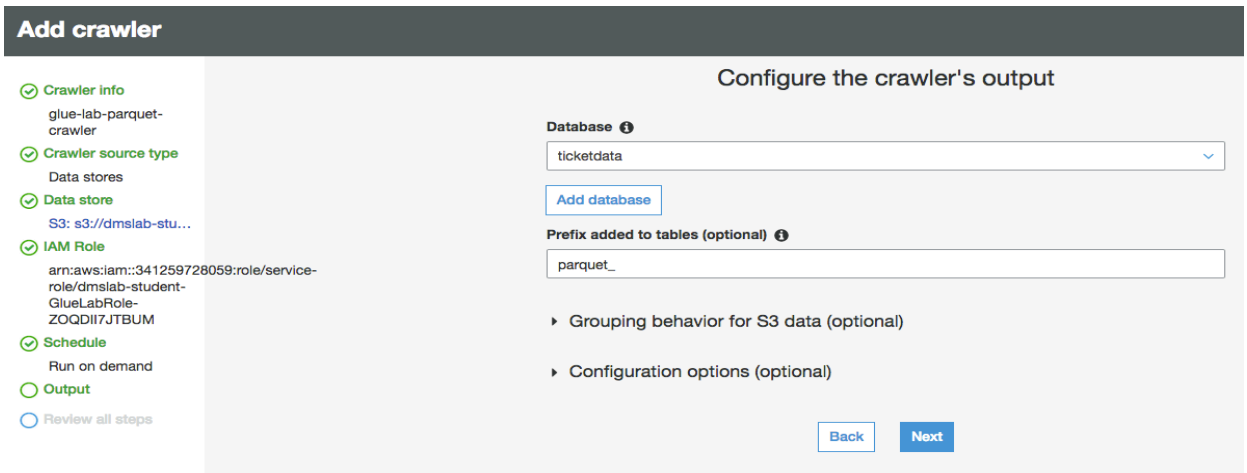
6. On the Choose an IAM role page, select **Choose an existing IAM role**. For IAM role, select the existing role "dmslab-student-GlueLabRole-ZOQDII7JTBUM" and Click **Next**.



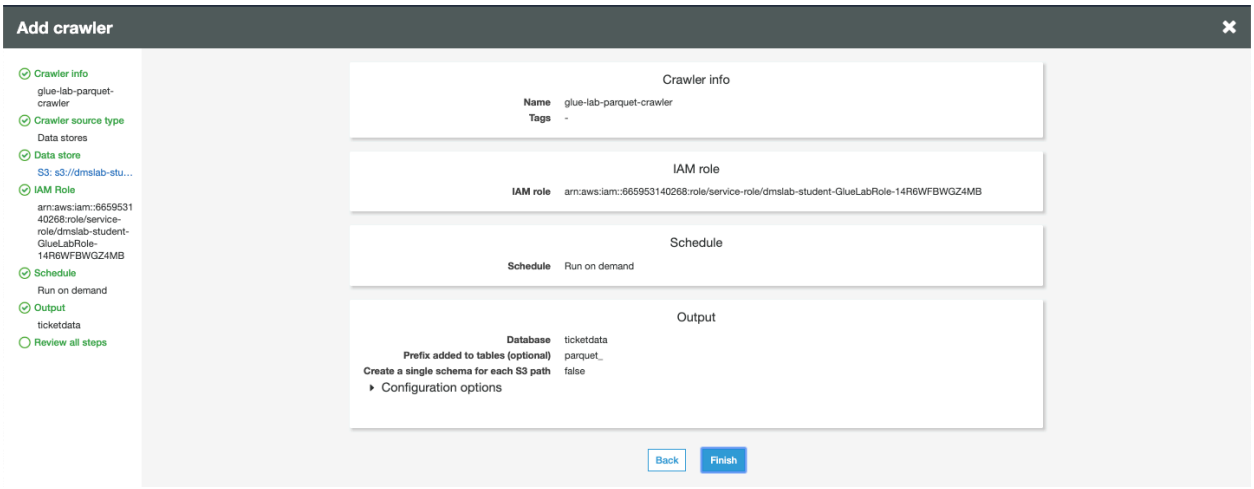
7. For **Frequency**, select "Run On Demand" and Click **Next**.



8. For the crawler's output database, choose your existing database which you created earlier e.g. "ticket-data"
9. For the **Prefix added to tables** (optional), type "**parquet_**"

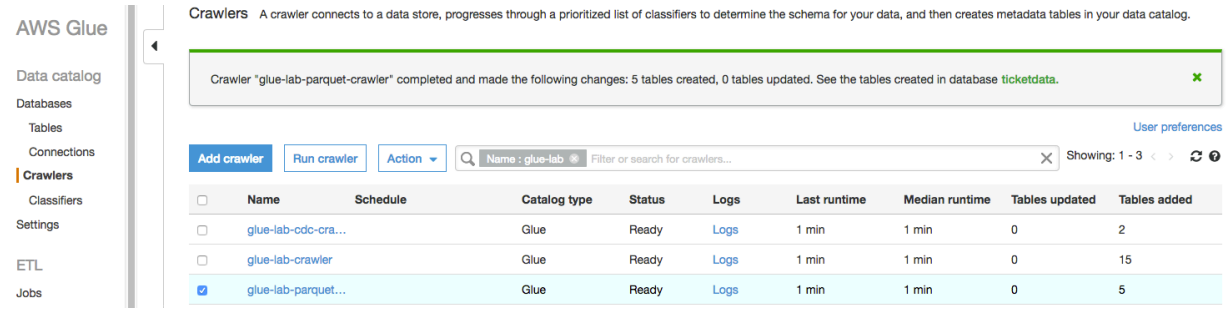


10. Review the summary page and click **Finish**.



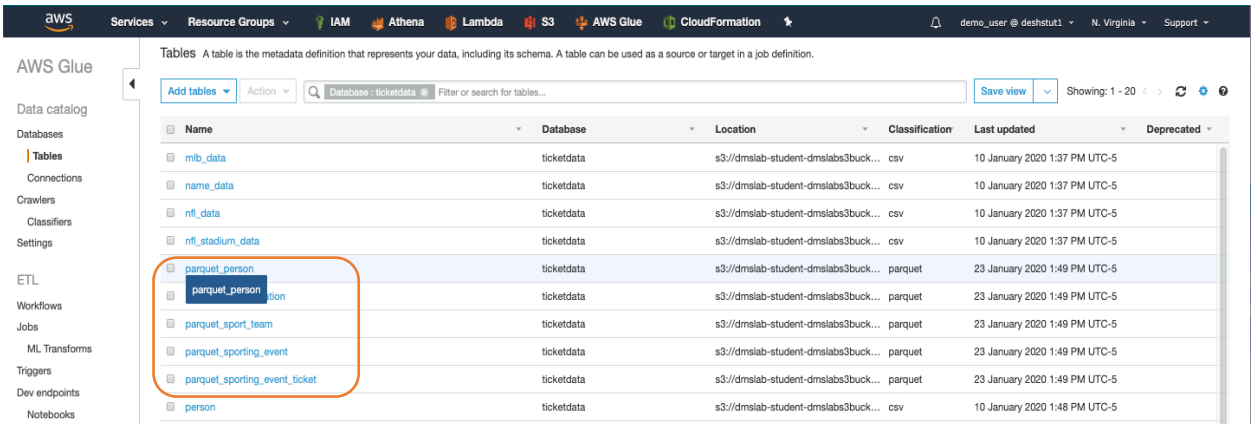
11. On the notification bar, click **Run it now**.

Once your crawler has finished running, you should report that 5 tables were added.



Confirm you can see the tables:

1. In the left navigation pane, click **Tables**.
2. Add the filter "parquet" to return the newly created tables.



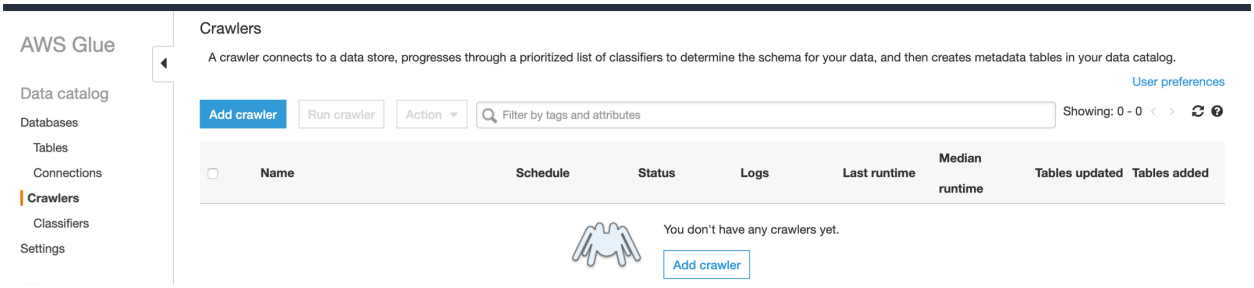
PART-(B): Glue Job Bookmark (Optional):

****Pre-requisite: Generate the CDC Data as part of DMS Lab****

Step 1: Create Glue Crawler for ongoing replication (CDC Data)

Now, let's repeat this process to load the data from change data capture.

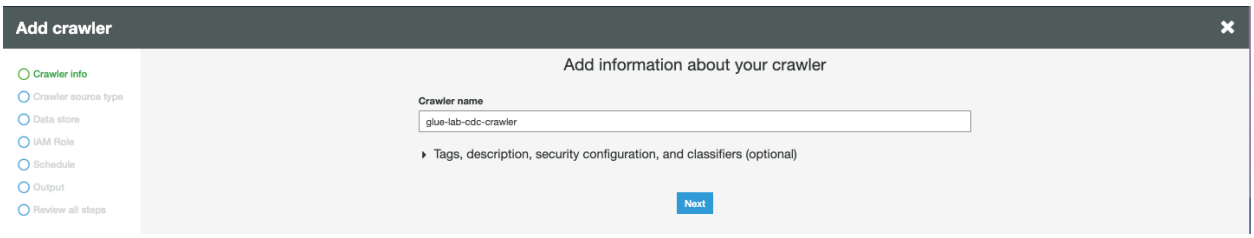
1. On the AWS Glue menu, select Crawlers.



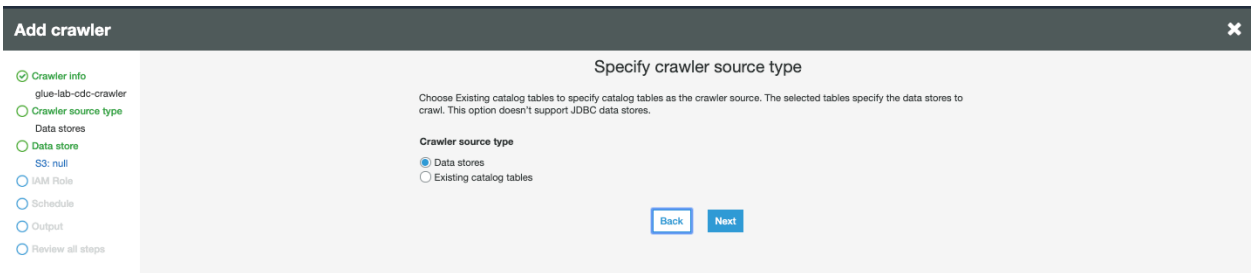
2. Click **Add crawler**.

3. Enter the crawler name for ongoing replication. This name should be descriptive and easily recognized (e.g., " **glue-lab-cdc-crawler**").

4. Optionally, enter the description. This should also be descriptive and easily recognized and Click **Next**.



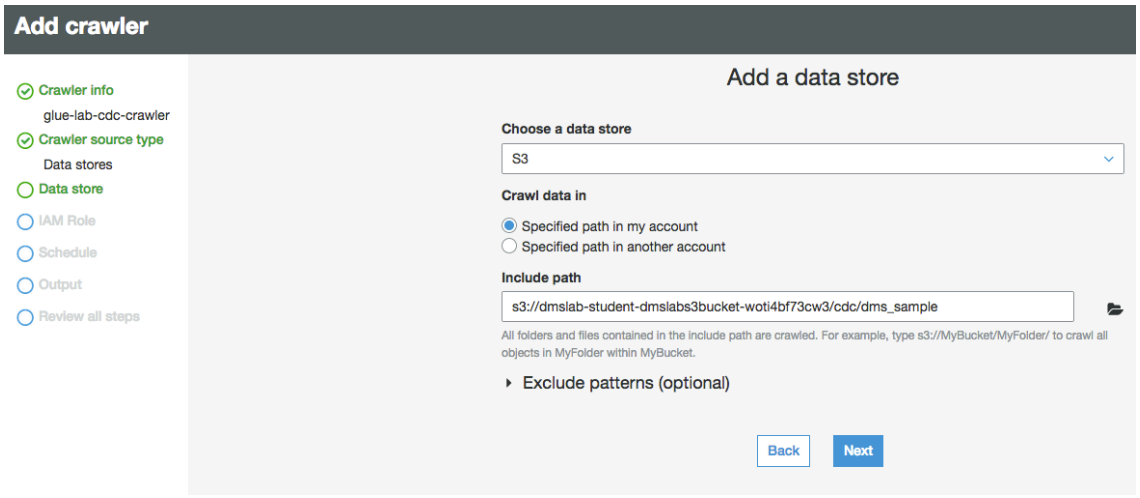
5. Choose **Crawler Source Type** as **Data Source** and Click **Next**



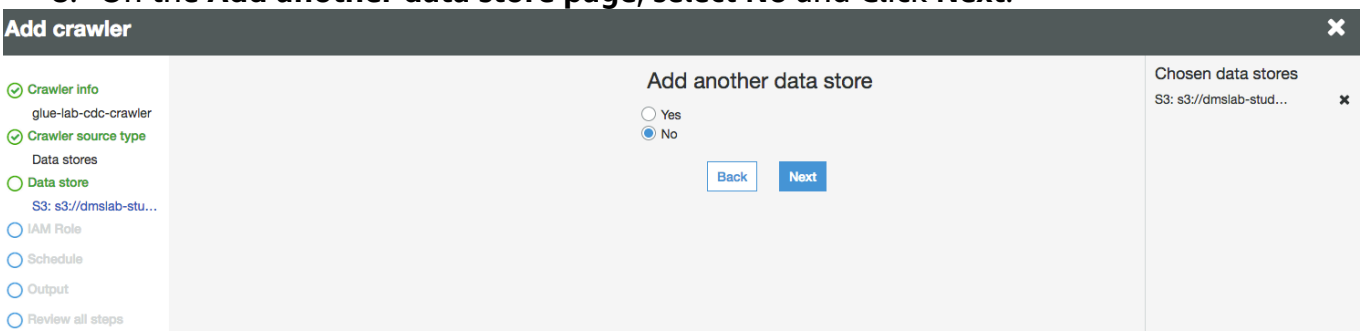
6. On the Add a data store page, make the following selections:
   a. For **Choose a data store**, click the drop-down box and select **S3**.

b. For **Crawl data in**, select **Specified path in my account**.
c. For **Include path**, enter the **target folder** for your DMS ongoing replication, e.g., "s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/**cdc/dms_sample**"

7. Click **Next**.

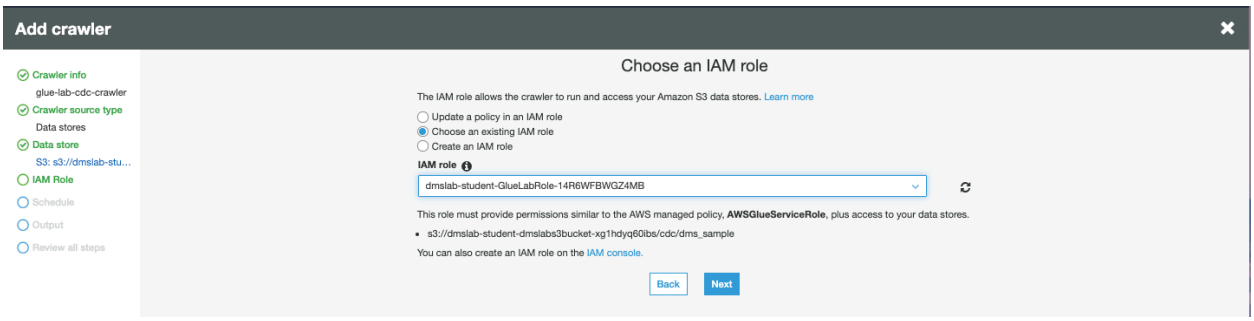


8. On the **Add another data store page**, select **No** and Click **Next**.

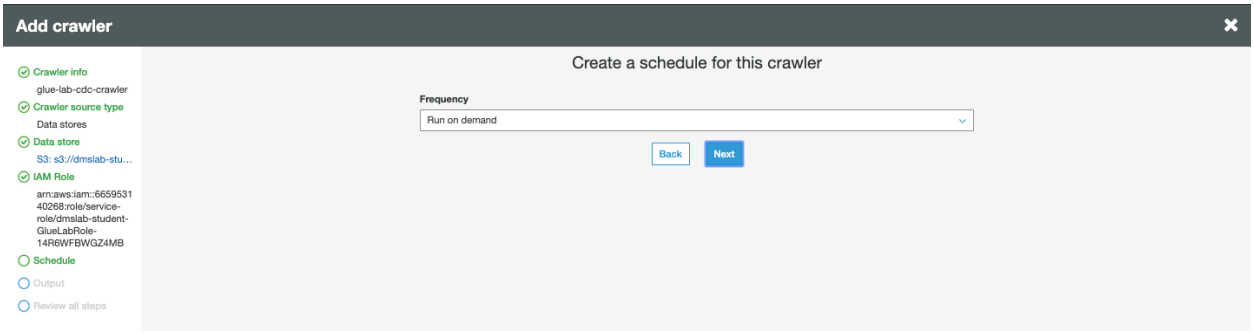


9. On the **Choose an IAM role** page, make the following selections:
   a. Select **Choose an existing IAM role**.
   b. **For IAM role**, select **<stackname>-GlueLabRole-<RandomString>**. E.g. "dmslab-student-GlueLabRole-ZOQDII7JTBUM"

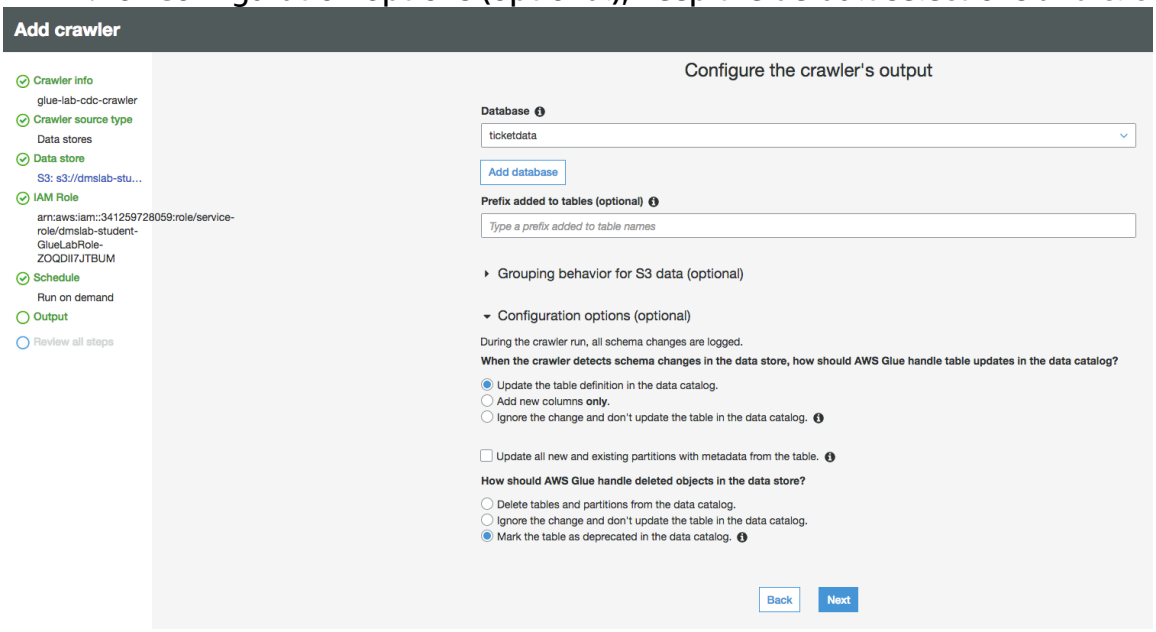
10. Click **Next**.



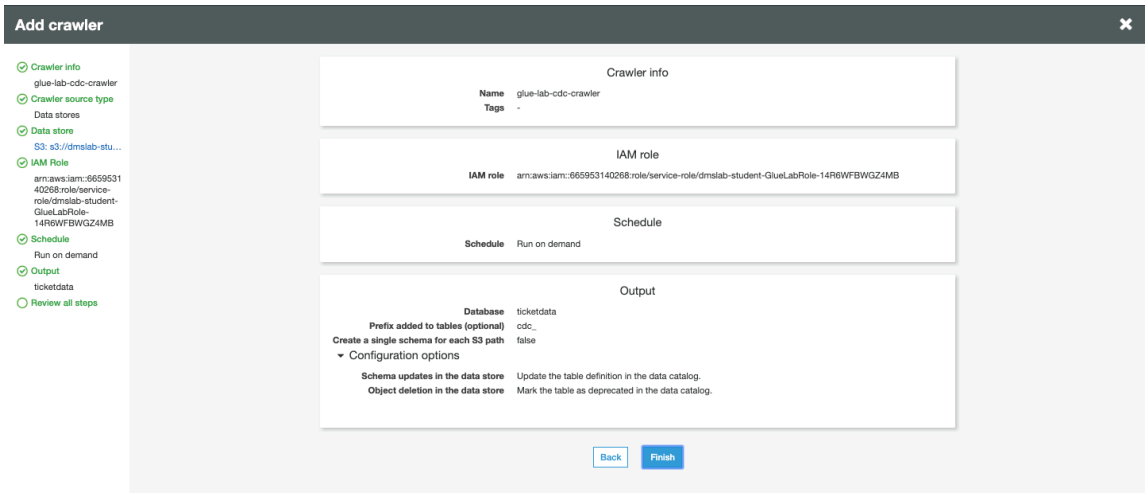
11. On the Create a schedule for this crawler page, for Frequency, select **Run on demand** and Click **Next**.



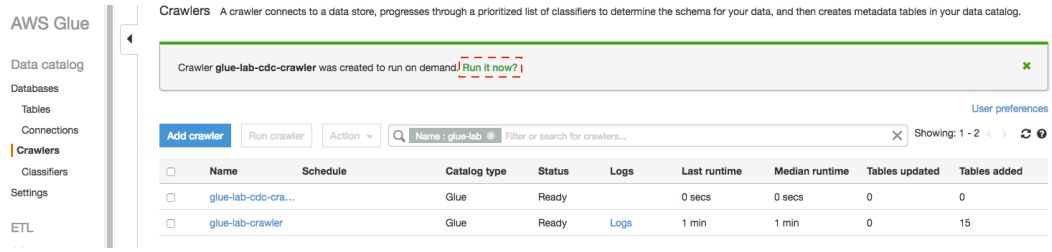
12. On the Configure the crawler's output page, select the existing **Database** for crawler output (e.g., "ticketdata").
13. For **Prefix added to tables (optional)**, specify "cdc_"
14. For Configuration options (optional), keep the default selections and click **Next**.



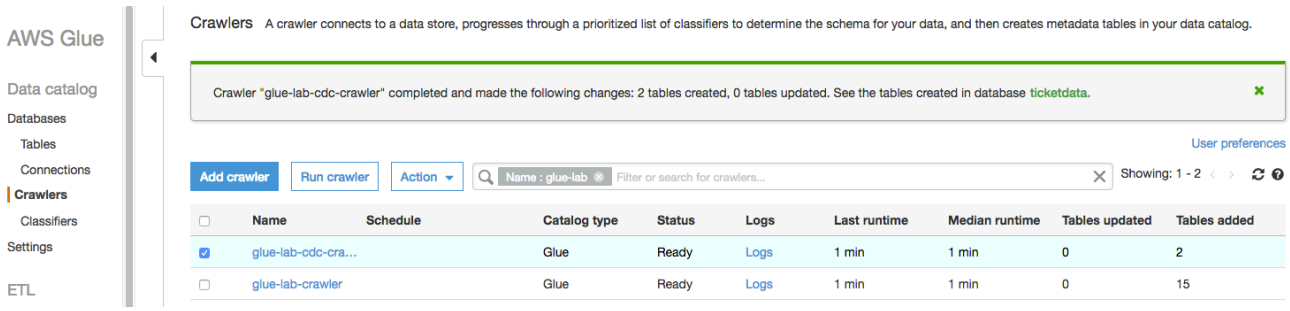
15. Review the summary page noting the Include path and Database target and Click **Finish**. The crawler is now ready to run.



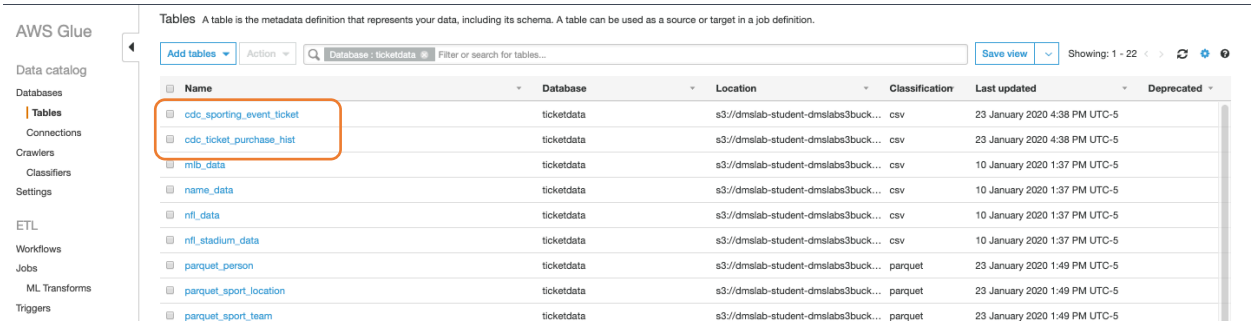
16. Click **Run it now**.



17. When the crawler is completed, you can see it has “Status” as **Ready,** Crawler will change status from starting to stopping, wait until crawler comes back to ready state, you can see that it has created 2 tables.



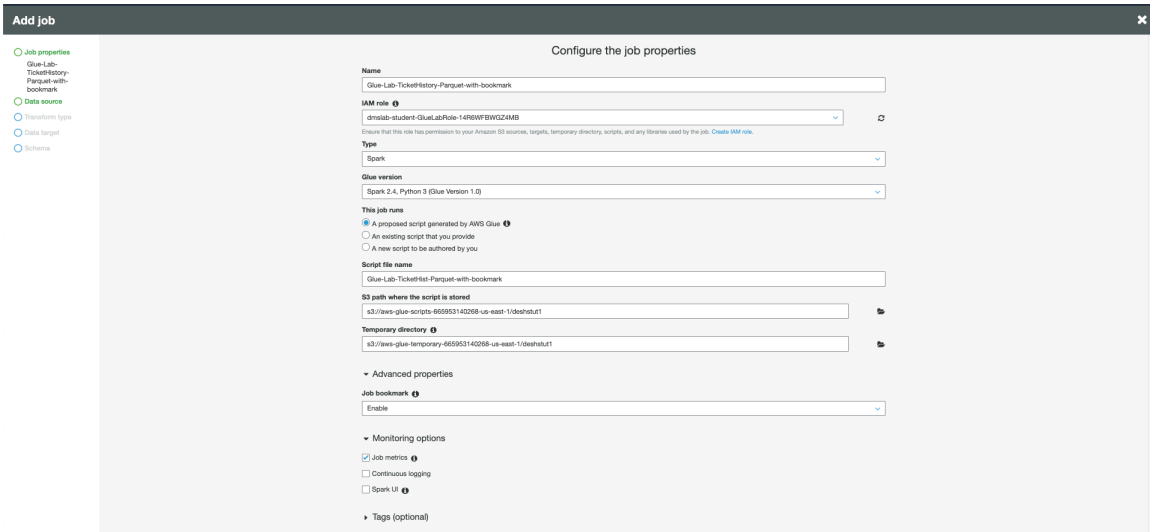
18. Click the database name (e.g., "ticketdata") to browse the tables. Specify "cdc" as the filter to list only newly imported tables.



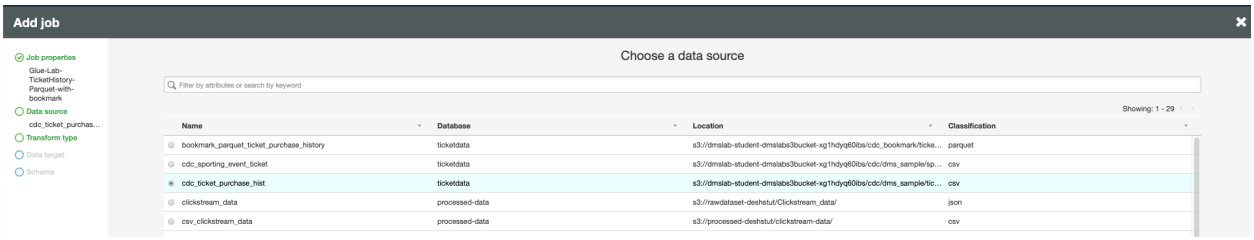
Step 2: Create a Glue Job with Bookmark Enabled

1. On the left-hand side of Glue Console, click on Jobs and then Click on Add Job

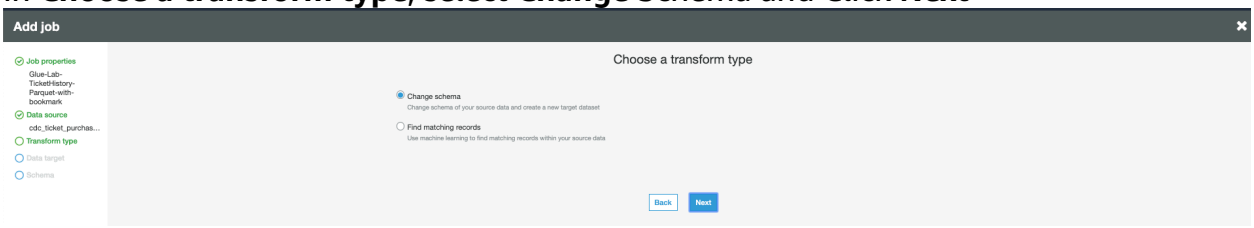
2. On the Job properties page, make the following selections:
    a. For **Name**, type **Glue-Lab-TicketHistory-Parquet-with-bookmark**.
    b. For **IAM role**, choose existing role "dmslab-student-GlueLabRole-ZOQDII7JTBUM"
    c. For **Type**, Select **Spark**
    d. For **Glue Version**, select **Spark 2.4, Python 3(Glue version 1.0)** or whichever is the latest version.
    e. For **This job runs**, select **A proposed script generated by AWS Glue**.
    f. For **Script file name**, type **Glue-Lab-TicketHistory-Parquet-with-bookmark**.
    g. For **S3 path where the script is stored**, provide a unique Amazon S3 path to store the scripts. (You can keep the default for this lab.)
    h. For **Temporary directory**, provide a unique Amazon S3 directory for a temporary directory. (You can keep the default for this lab.)
3. Expand the **Advanced properties** section. For Job bookmark, select **Enable** from the drop down option.
4. Expand on the **Monitoring** options, check for **Job metrics**.
5. Click **Next**



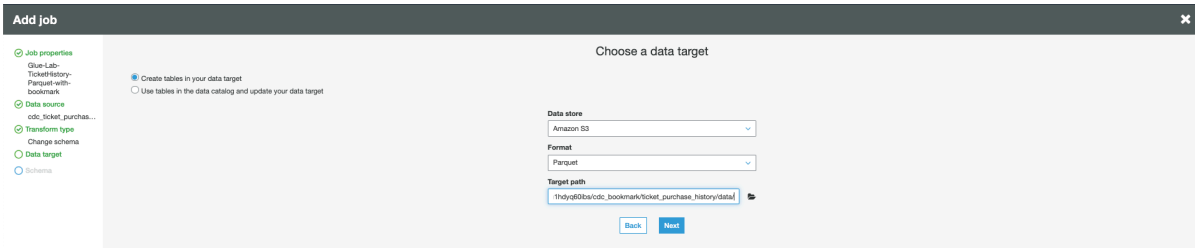
6. In **Choose a data source**, select **cdc_ticket_purchase_hist** as we are generating new data entries for **ticket_purchase_hist table**. Click **Next**



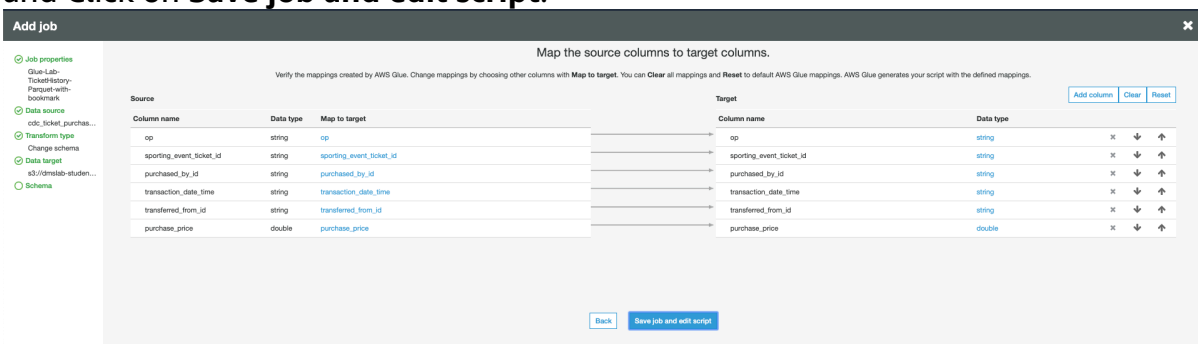
7. In **Choose a transform type**, select **Change** Schema and Click **Next**



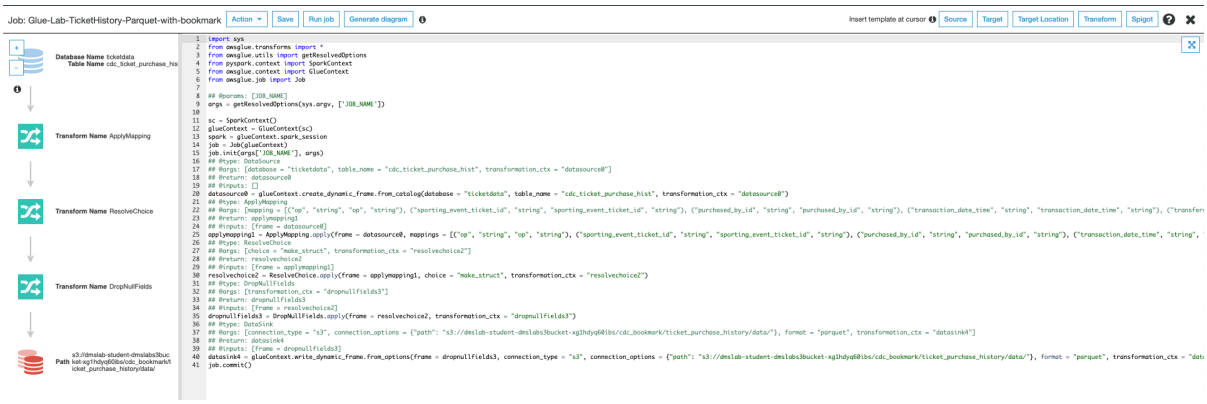
8. In Choose a data target:
    a. For **Data store**: select amazon **S3**
    b. Format: **parquet**
    c. **Target path**: s3://<dms-lab-bucket-path>/cdc_bookmark/ticket_purchase_history_data/
    d. Click **Next**



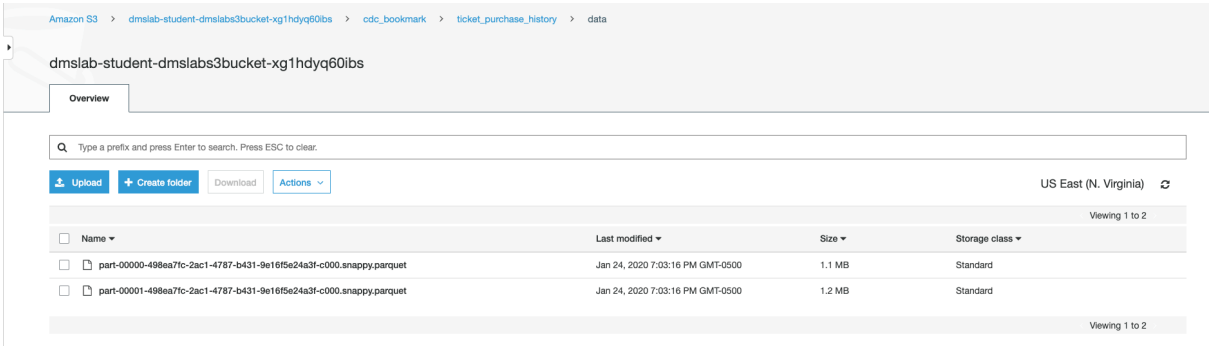
9. In map the source columns to target columns window, leave everything default and Click on **Save job and edit script**.



10. In the next window, review the job script and click on **Run job**. Click on close mark on the top right of the window to close the screen.

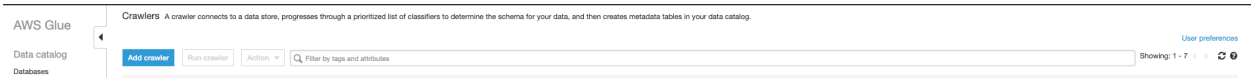


11. Once the job finishes its run, check the **S3 bucket** for the parquet partitioned data.

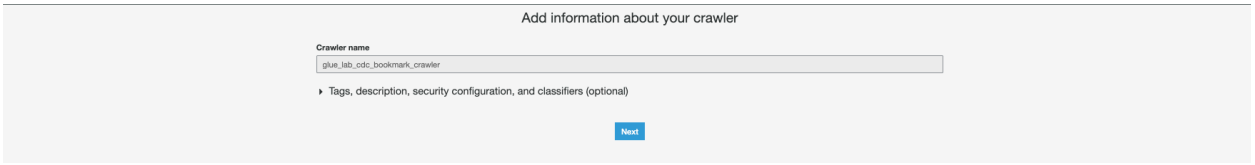


Step 3: Create Glue crawler for Parquet data in S3

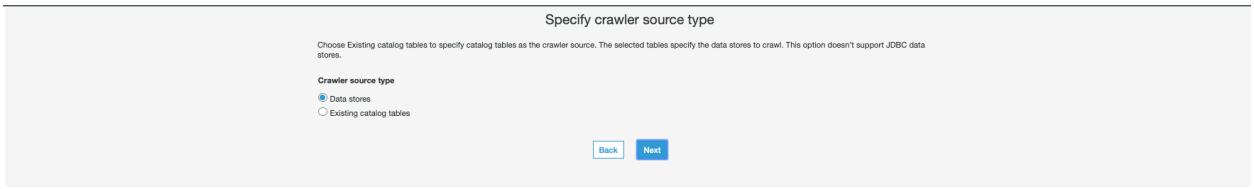
1. Once you have the data in S3 bucket, navigate to **Glue Console** and now we will crawl the parquet data in S3 to create data catalog.
2. Click on **Add crawler**



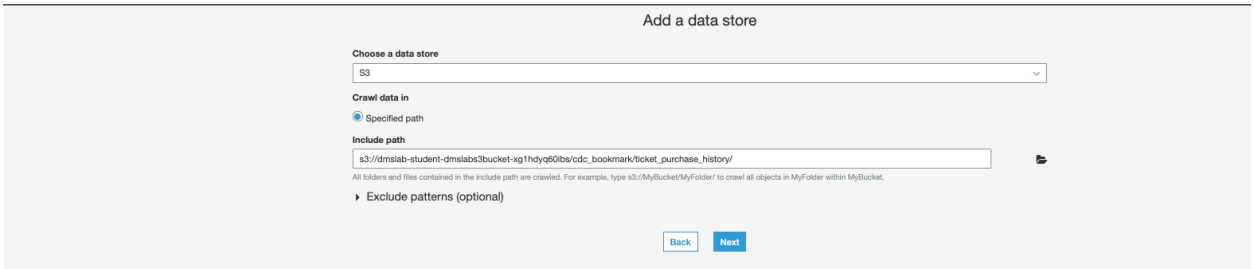
3. In crawler configuration window, provide crawler name as **glue_lab_cdc_bookmark_crawler** and Click **Next**.



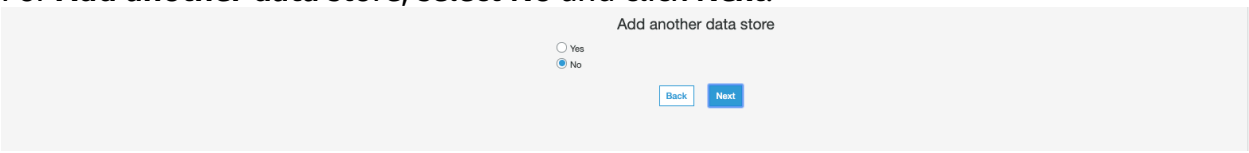
4. In specify **crawler source type**, for crawler source type, select **Data stores**. Click **Next**



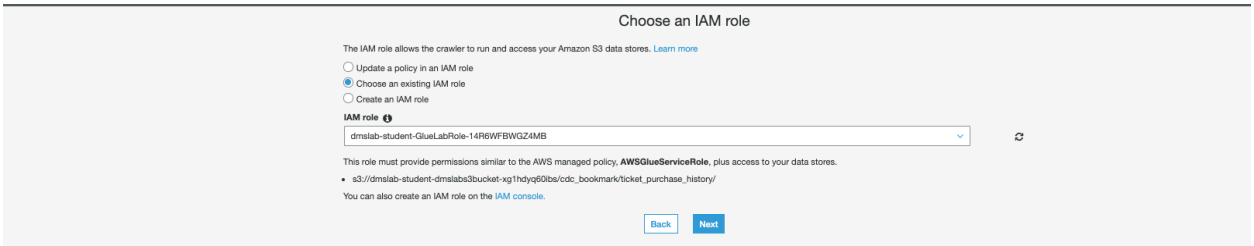
5. In **Add a data store**:
    a. For **Choose a data store**, select **S3**
    b. For the path, provide this: s3://<dms-lab-bucket-path> and add /cdc_bookmark/ticket_purchase_history/.
6. Click on **Next**



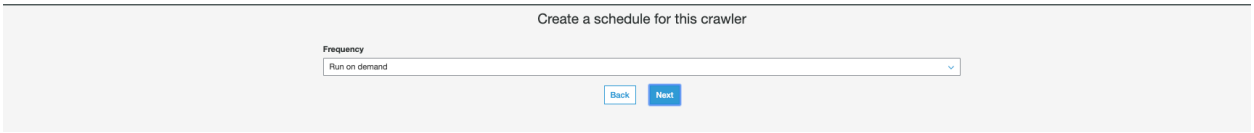
7. For **Add another data** store, select **No** and click **Next**.



8. In **Choose an IAM role**, select Choose an existing IAM role and select the role that you created as part of the DMS_Student Lab. (for eg, this role name looks something like this: dmslab-student-GlueLabRole-<random-alphanumeric-characters>

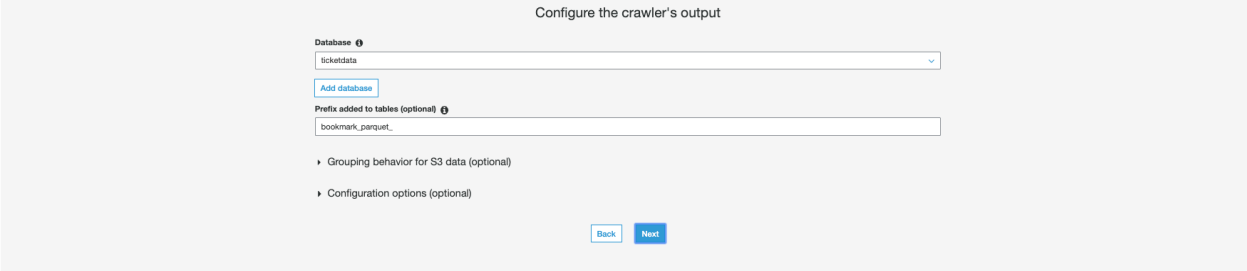


9. For setting the **frequency** in create a schedule for this crawler, select “Run on demand”. Click **Next**

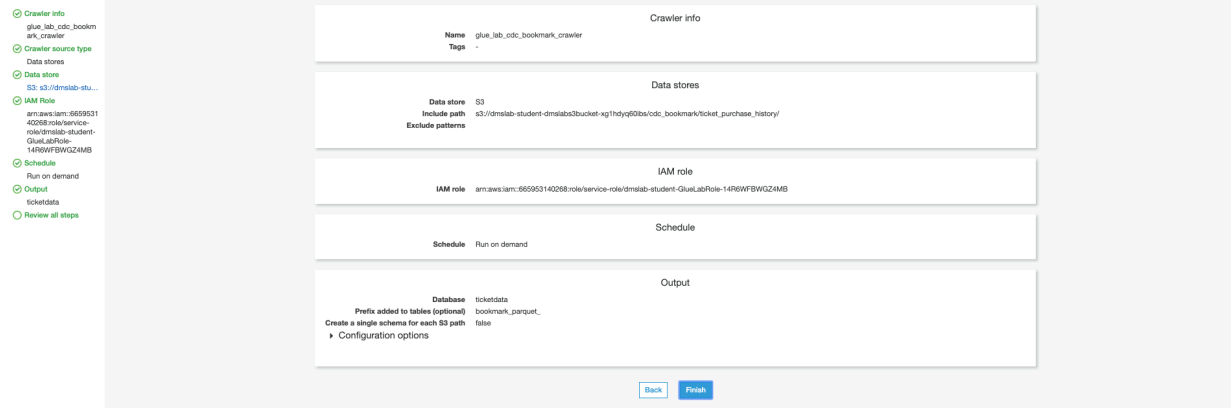


10. For the crawler’s output:
    a. For Database, select “**ticket**” database.
    b. Optionally, add prefix to the newly created tables for easy identification. Provide the prefix as “**bookmark_parquet_**”

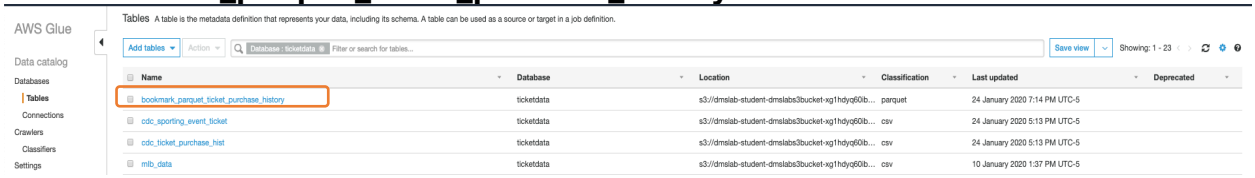
c. Click **Next**



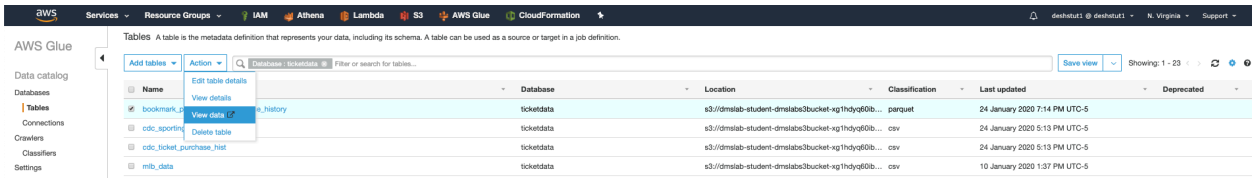
11. Review all the details and click on **Finish**. Next, **run the crawler**.



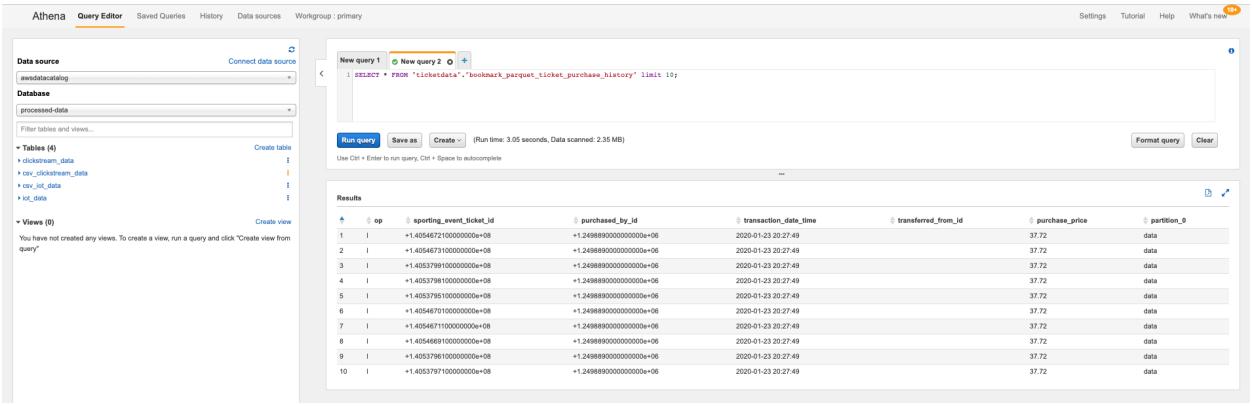
12. After the crawler finishes running, click on Databases, select "**ticketdata**" and view tables in this database. You will find the newly created table as "**bookmark_parquet_ticket_purchase_history**"



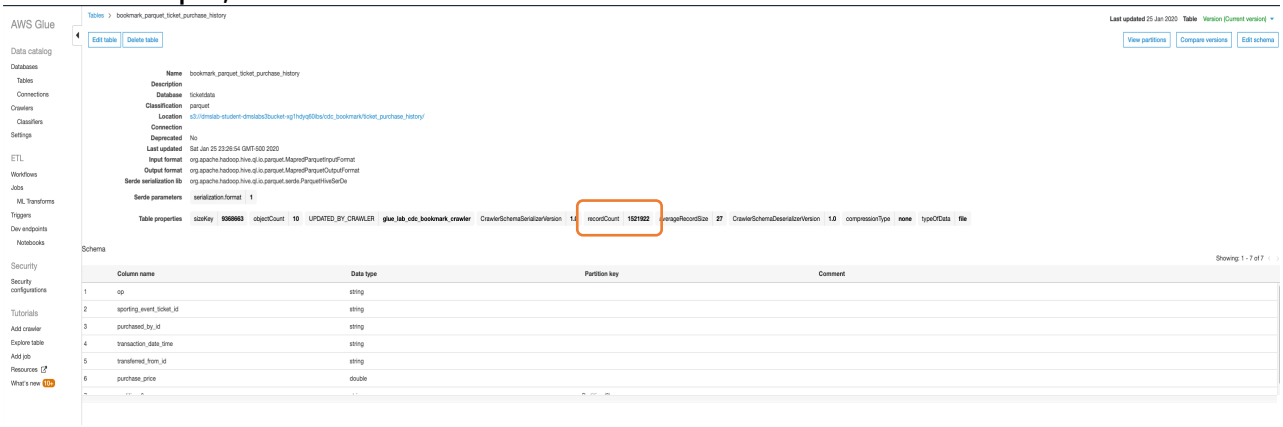
13. Once the table is created, click on **Action** and from **dropdown** select **View Data.**



14. This will take you to **Athena console** and a prebuilt query will be run to display few entries of the table.



15. Before moving on to next step, note the "**recordcount**" for "**bookmark_parquet_ticket_purchase_history**". This will be used at the later part. In this example, the current count is: 1521922

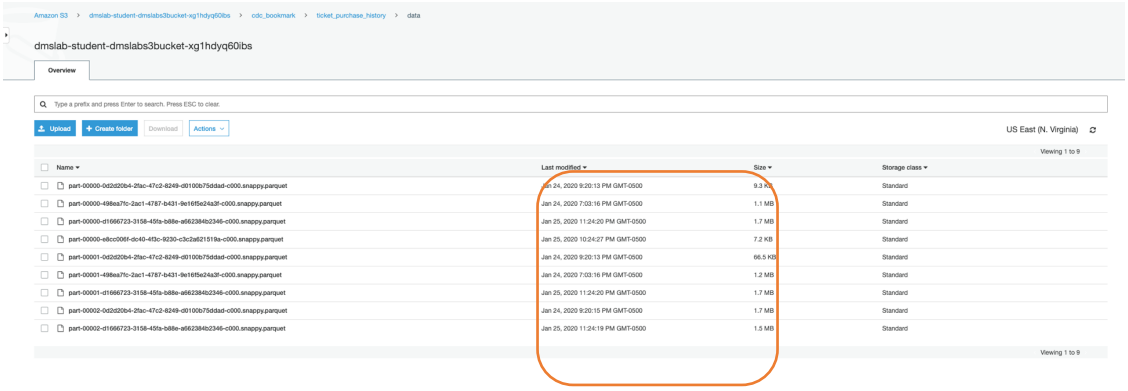


Step 4: Generate CDC data and to observe bookmark functionality

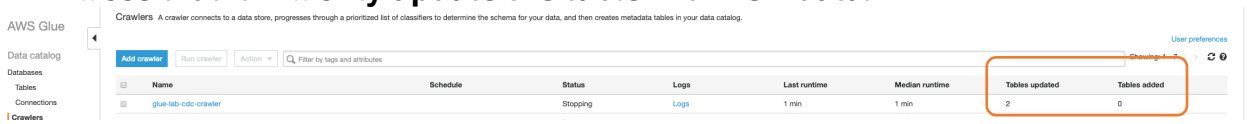
Your instructor will generate CDC activity which above migration task will capture, if you ran the instructor setup on your own, then make sure to follow "**Generate the CDC Data"** section from instructor lab.

You may need to wait 5 to 10 minutes for CDC data to first reflect in your RDS postgres database and then picked up by DMS CDC migration task.

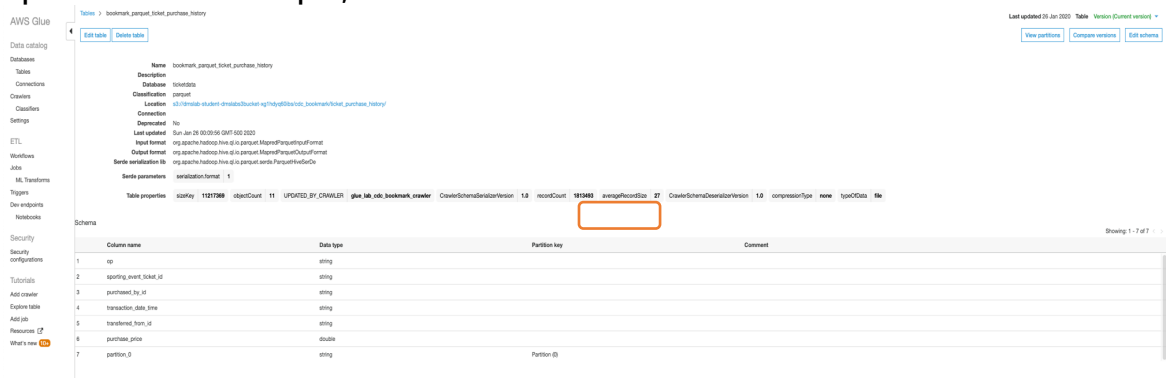
1. To make sure the new data has been successfully generated, check the S3 bucket for cdc data, you will see new files generated. Note the time when the files were generated.



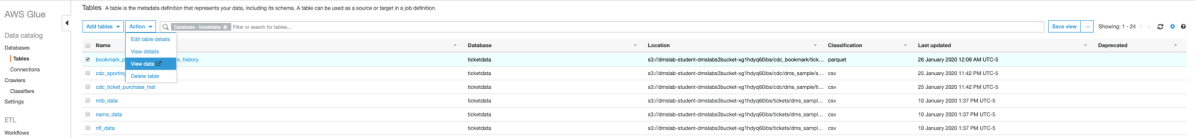
2. Repeat Step 1 – Step 3. When you run the “glue-lab-cdc-crawler” again, you will see that it will **only update the table with new data**:



3. Once the crawler finishes, note down the new record count after the table update. In this example, the new record count is: 1813493.

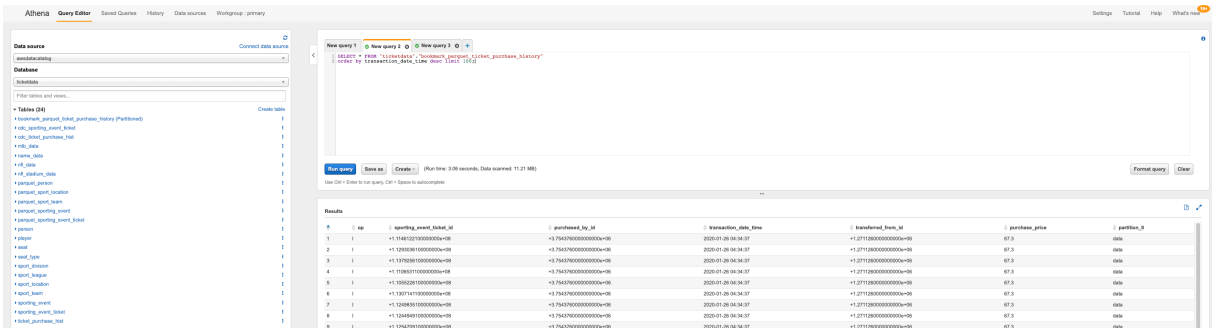


4. Once you run the crawler In Step 3, select the “**bookmark_parquet_ticket_purchase_history**” from the Table section and click on **Action->View Data**. This will take you to Athena console.



5. On Athena Console, run the following query:

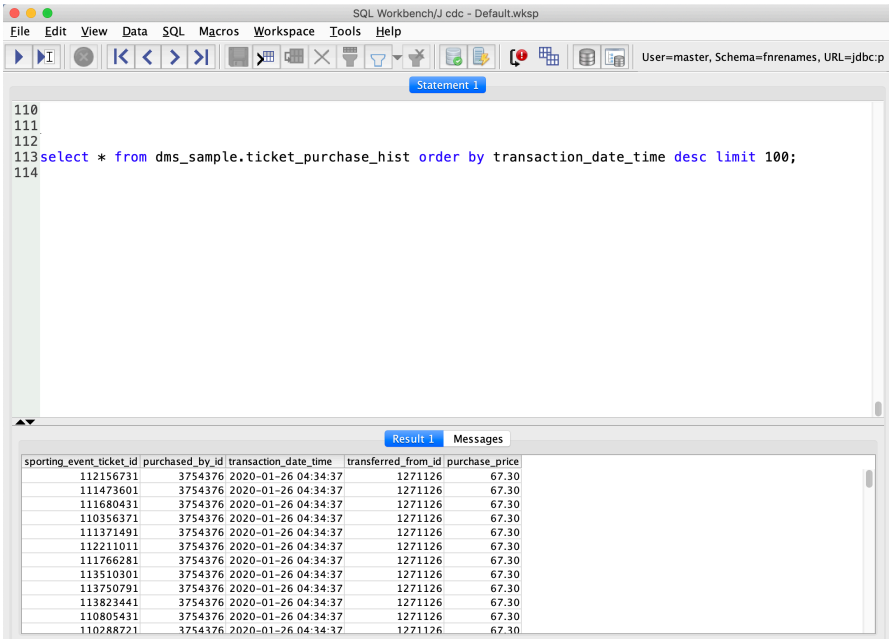
   SELECT * FROM "ticketdata"."bookmark_parquet_ticket_purchase_history" order by transaction_date_time desc limit 100;



Run the same query against RDS instance, by connecting to your RDS instance through SQL Workbench. (This has been covered in previous Lab, however, we are providing details for your convenience)

In SQL Workbench connection window, provide the following:

a) Driver: PostgreSQL (org.postgresql.Driver)
b) URL: jdbc:postgresql://<endpoint-rds-instance>:5432/sportstickets
c) Username: master
d) Password: master123



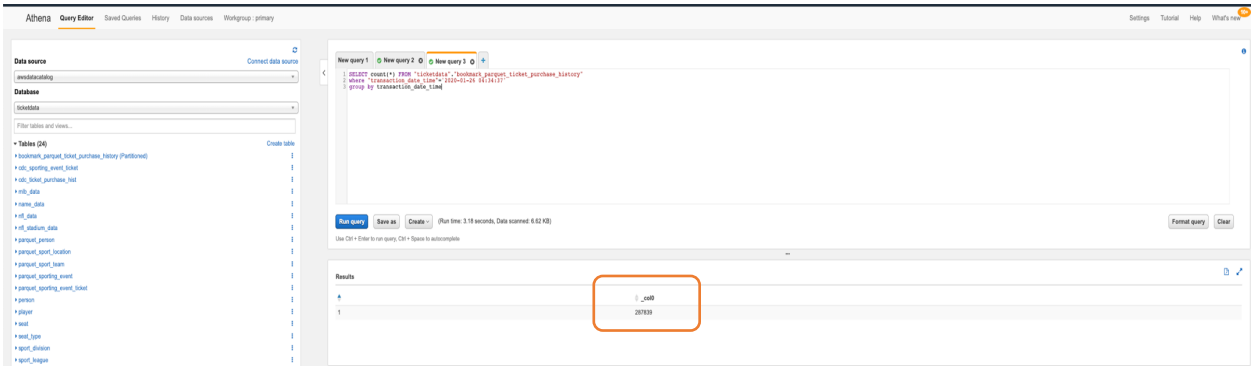
You will notice that the results for the column “transaction_date_time” and value of “purchase_price” is similar for the last 100 entries in SQL Workbench and in Athena Console. The result matches which shows that the new and latest has been replicated and stored in our table.

Now let’s make sure that only the new data was scanned and added to the destination table by our **Glue Job with Bookmark enabled**. To validate the functioning of bookmark, timestamp values are used, in order to make sure only newly added data is scanned and added. In this example,

“transaction_date_time” is the timestamp value used by Job Bookmark and will be used to showcase the functionality.
Note the “transaction_date_time” value from the previous SQL query and then Run the following query:

SELECT count(*) FROM
"ticketdata"."bookmark_parquet_ticket_purchase_history"
where "transaction_date_time"='2020-01-26 04:34:37'
group by transaction_date_time

"transaction_date_time"='2020-01-26 04:34:37' is a subset of the newly added data.



Since the data we are querying is a subset of newly added data, The result returned by this query should be less than or equal to the difference of record count for table: "bookmark_parquet_ticket_purchase_history" before and after running Glue Job with bookmark enabled.

In this example: (1813493-1521922)= 291571) >287839.

This validates that only new data was scanned and added by Glue job with bookmark enabled rather than scanning the entire data from source table and only new data entries were added to the destination table.

PS: *Reference to timestamp is transaction_date_time value of the table which is used to show the bookmark functionality.*

When you are building an enterprise use cases, it’s become important to automate entire pipeline and add notification. Please refer below blogs to try out end to end servlets datalike automation:

Build and automate a serverless data lake using an AWS Glue trigger for the Data Catalog and ETL jobs:
https://aws.amazon.com/blogs/big-data/build-and-automate-a-serverless-data-lake-using-an-aws-glue-trigger-for-the-data-catalog-and-etl-jobs/

PART- (C): Glue Workflows (Optional)

Overview:

In AWS Glue, you can use workflows to create and visualize complex extract, transform, and load (ETL) activities involving multiple crawlers, jobs, and triggers. Each workflow manages the execution and monitoring of all its components. As a workflow runs each component, it records execution progress and status, providing you with an overview of the larger task and the details of each step. The AWS Glue console provides a visual representation of a workflow as a graph.

Creating and Running Workflows:

Above mentioned Part A (ETL with Glue) and Part B (Glue Job Bookmarks) can be created and executed using workflows. Complex ETL jobs involving multiple crawlers and jobs can also be created and executed using workflows in an automated fashion. Below is a simple example to demonstrate how to create and run workflows.

****Pre-requisite before creating workflow****
To store processed data you need new location. Please Follow this user guide to create folder following structure in your S3 bucket to store parquet file - https://docs.aws.amazon.com/AmazonS3/latest/user-guide/create-folder.html .
Full path will look like e.g. – "s3://dmslab-student-dmslabs3bucket-woti4bf73cw3/tickets/dms_parquet/ mlb_data/data/"

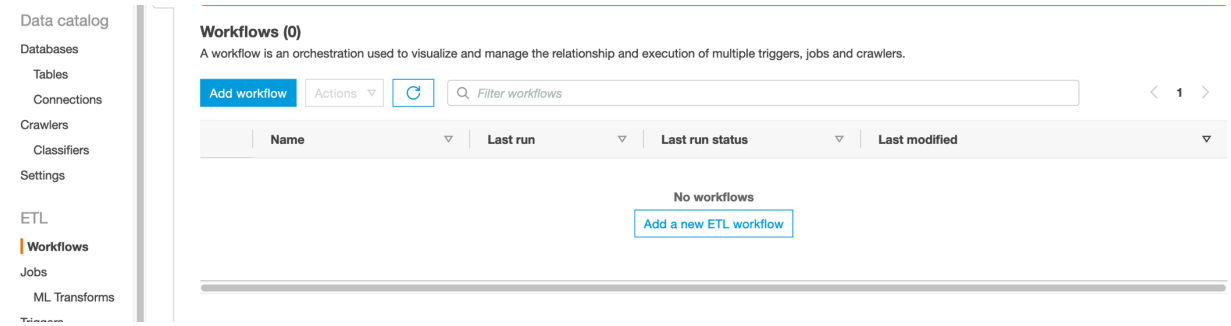
You need to have **Glue Jobs and Crawlers prebuilt in order to create workflow**. For this exercise, we will select the **table** "**mlb_data**" from "**ticketdata**" **database** and create a glue job and crawler in a similar fashion as you created in Part A of this lab, with these details:

a) **Glue Job:**
   - Name: **Glue-Lab-MLBParquet**
   - Source: mlb_data table under ticket database
   - Transformation format: Parquet
   - Destination: s3://<dms-lab-bucket>/dms_parquet/mlb_data/data/

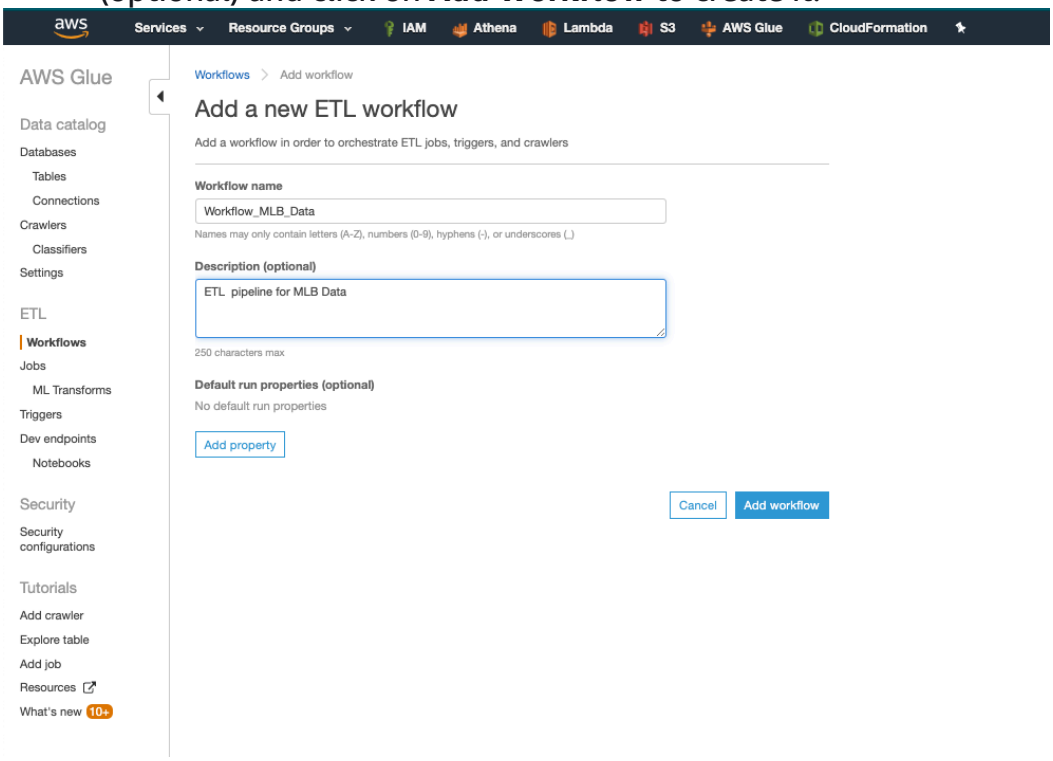
b) **Glue crawler:**
   - Name: **glue-lab-mlbdata-crawler**
   - Source: <dms-lab-bucket>/dms_parquet/mlb_data/data/
   - Destination Database: ticketdata
   - Table prefix: workflow_

To create a workflow:

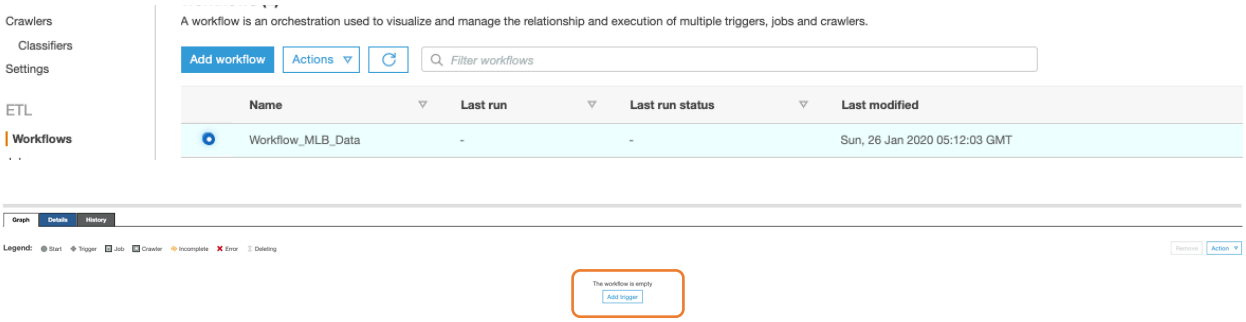
1. Navigate to **AWS Glue Console** and under **ETL**, click on **Workflows**. Then Click on **Add Workflow**.



2. Give the workflow name as "**Workflow_MLB_Data**". Provide a description (optional) and click on **Add Workflow** to create it.

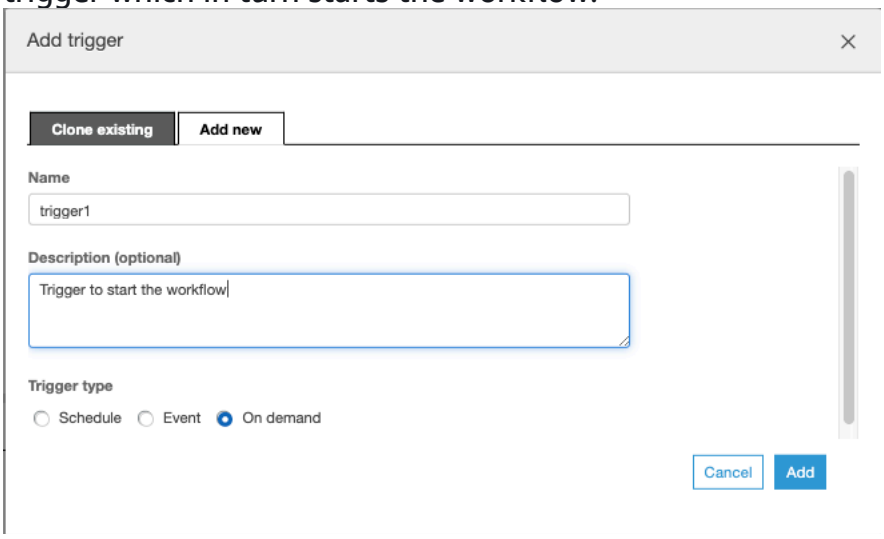


3. Click on the **workflow** and scroll to the bottom of the page. You will see an option **Add Trigger**. Click on that button.

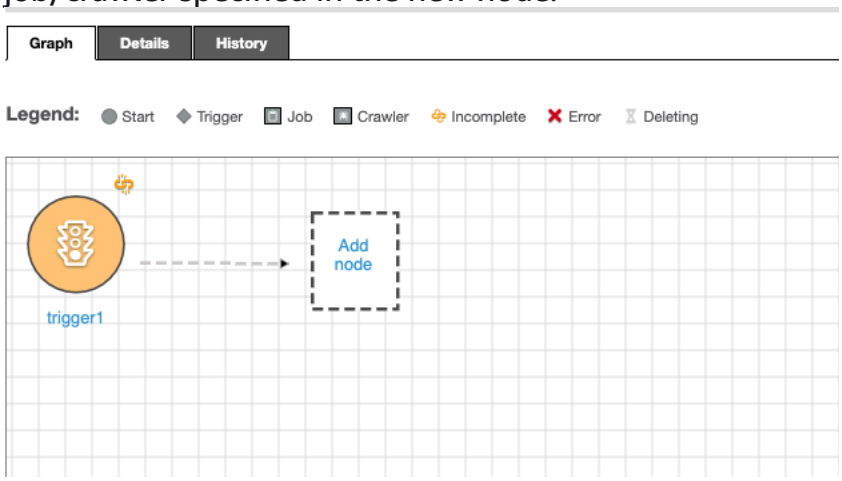


4. In **Add Trigger** window, From Clone Existing and Add New options, click on **Add New**.
    a. Provide **Name** as "**trigger1**"
    b. Provide a **description**: Trigger to start workflow
    c. **Trigger type**: **On-demand**.
    d. Click on **Add**

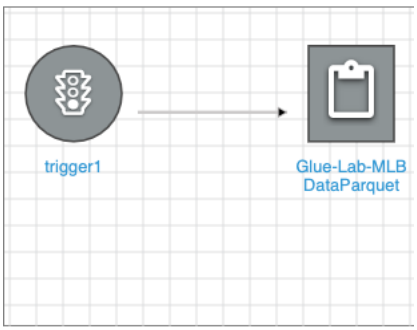
    Triggers are used to initiate the workflow and there are multiple ways to invoke the trigger. Any scheduled operation or any event can activate the trigger which in turn starts the workflow.



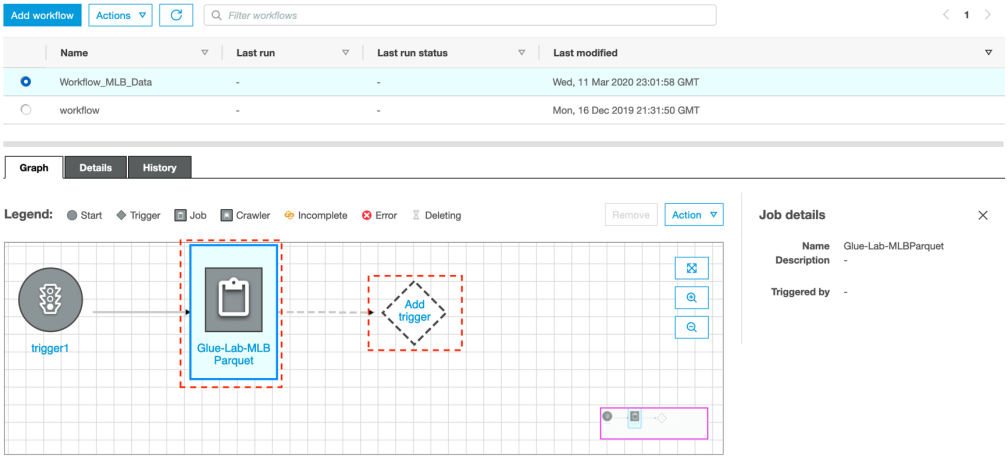
5. Click on **trigger1** to add a **new node**. New Node can be a crawler or job, depending upon the workflow you want to build. Make sure you add node only after clicking on trigger so that whenever the "trigger1" is **activated**, it triggers job/crawler specified in the new node.



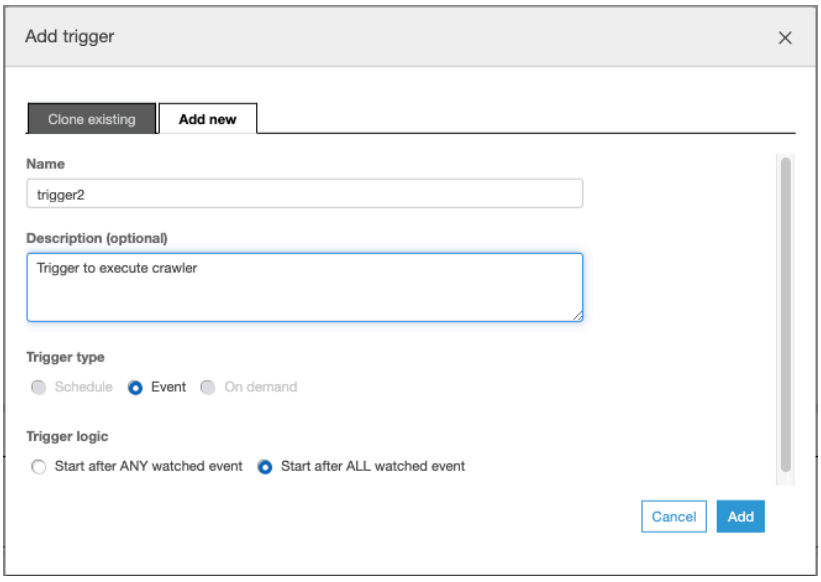
6. Click on "**Add Node**". A new window to add jobs or crawlers will open. Select the **job Glue-Lab-MLBDataParquet**



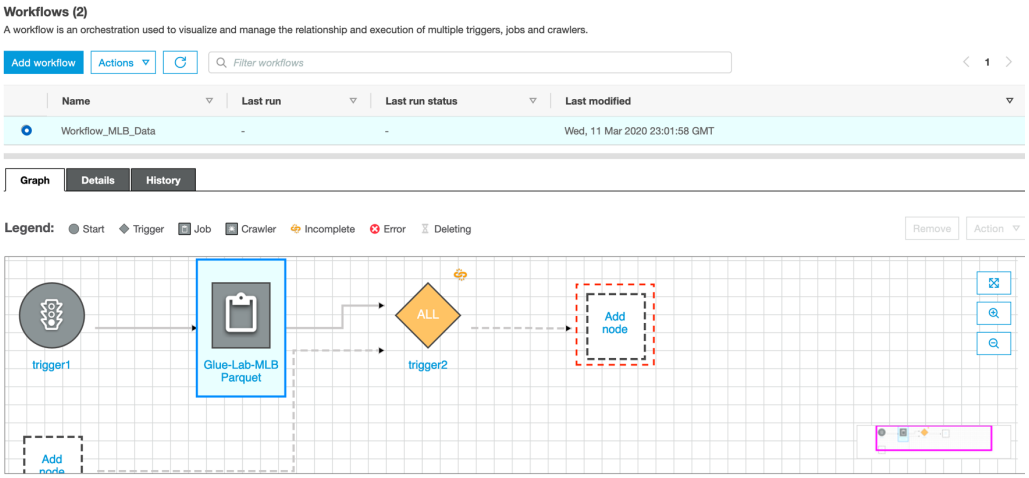
7. Click on **Glue-Lab-MLBDataParquet** and **Add Trigger** will appear as shown in below screen.



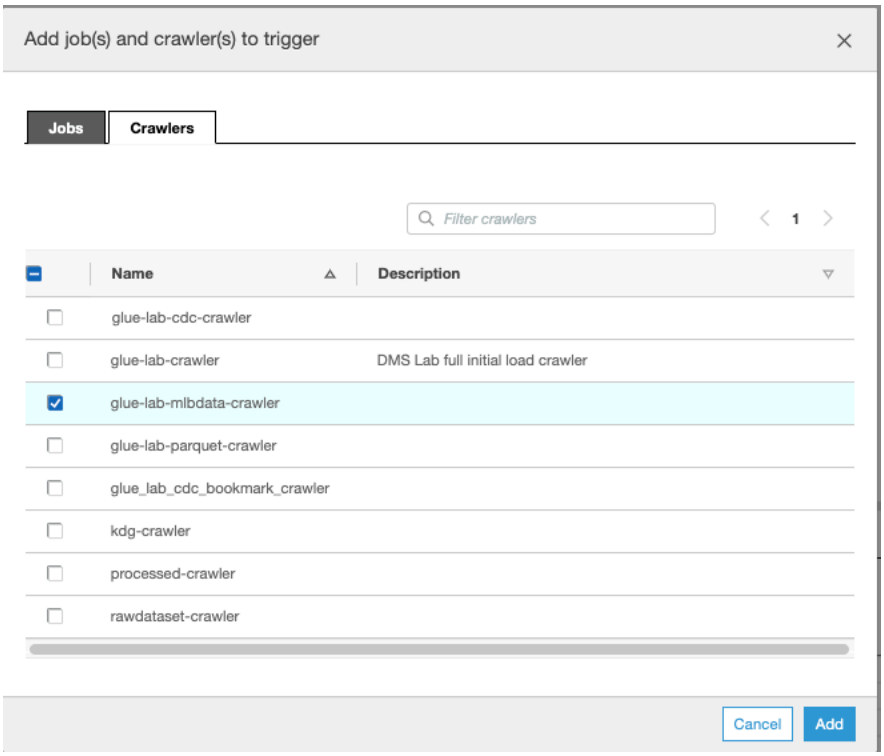
8. Click on **Add trigger**, provide the following:
    a. **Name**: **trigger2**
    b. **Description**: Trigger to execute crawler
    c. **Trigger type**: **Event**
    d. **Trigger logic**: **Start after ALL watched event.** This will make sure that crawler starts once Glue job finishes processing of ALL data. Click **Add**



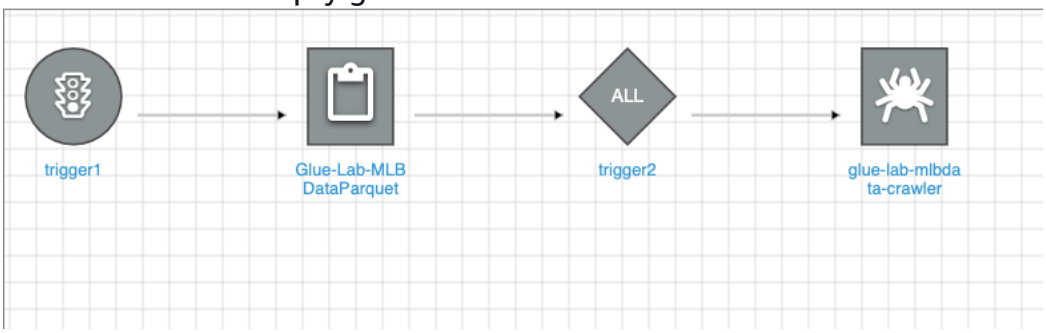
9. After **trigger2** is added to workflow, Click on **Add node** which is connected to **trigger 2** as highlight below:



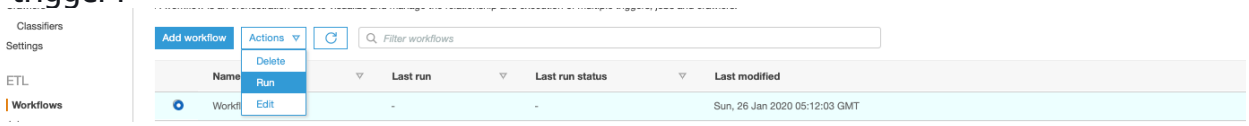
10. Select **crawler** option and then chose "**glue-lab-mlbdata-crawler"**. Click **Add**.



11. Now click on an empty grid and workflow will look like below:



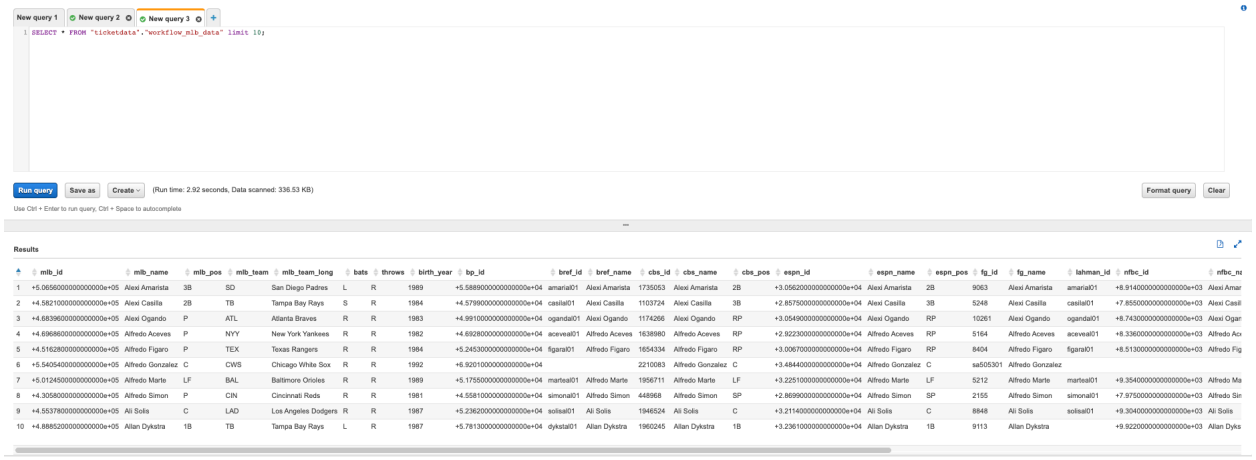
12. Select your workflow, click on **Actions->Run** and this will start the first trigger "trigger1"



13. Now the first node will be executed, i.e. Glue Job and subsequently all other nodes will be executed.
14. Once finished, the workflow will be shown as **completed**.
15. You can click on any node at any time of processing of workflow, to get more details about that particular stage of processing. This gives you detailed level view for monitoring your pipeline.

16. Once the workflow is completed, you will observe that glue job and crawlers have been successfully executed and the table has been created.

17. Let's query the data in Athena. Select "**workflow_mlb_data**" table and click on **Actions->View Data.**



	mlb_id	mlb_name	mlb_pos	mlb_team	mlb_team_long	bats	throws	birth_year	bp_id	bref_id	bref_name	cbs_id	cbs_name	cbs_pos	espn_id	espn_name	espn_pos	fg_id	fg_name	lahman_id	nfbc_id	nfbc_na
1	+5.06560000000000e+05	Alexi Amarista	3B	SD	San Diego Padres	L	R	1989	+5.58890000000000e+04	amarial01	Alexi Amarista	1735053	Alexi Amarista	2B	+3.05620000000000e+04	Alexi Amarista	2B	9063	Alexi Amarista	amarial01	+8.91400000000000e+03	Alexi Amar
2	+4.58210000000000e+05	Alexi Casilla	2B	TB	Tampa Bay Rays	S	R	1984	+4.57990000000000e+04	casilal01	Alexi Casilla	1103724	Alexi Casilla	3B	+2.85750000000000e+04	Alexi Casilla	3B	5248	Alexi Casilla	casilal01	+7.85500000000000e+03	Alexi Casil
3	+4.68396000000000e+05	Alexi Ogando	P	ATL	Atlanta Braves	R	R	1983	+4.99100000000000e+04	ogandal01	Alexi Ogando	1174266	Alexi Ogando	RP	+3.05490000000000e+04	Alexi Ogando	RP	10261	Alexi Ogando	ogandal01	+8.74300000000000e+03	Alexi Ogan
4	+4.69686000000000e+05	Alfredo Aceves	P	NYY	New York Yankees	R	R	1982	+4.69280000000000e+04	aceveal01	Alfredo Aceves	1638980	Alfredo Aceves	RP	+2.92230000000000e+04	Alfredo Aceves	RP	5164	Alfredo Aceves	aceveal01	+8.33600000000000e+03	Alfredo Ac
5	+4.51628000000000e+05	Alfredo Figaro	P	TEX	Texas Rangers	R	R	1984	+5.24530000000000e+04	figaral01	Alfredo Figaro	1654334	Alfredo Figaro	RP	+3.00670000000000e+04	Alfredo Figaro	RP	8404	Alfredo Figaro	figaral01	+8.51300000000000e+03	Alfredo Fig
6	+5.54054000000000e+05	Alfredo Gonzalez	C	CWS	Chicago White Sox	R	R	1992	+6.92010000000000e+04			2210083	Alfredo Gonzalez	C	+3.48440000000000e+04	Alfredo Gonzalez	C	sa505301	Alfredo Gonzalez			
7	+5.01245000000000e+05	Alfredo Marte	LF	BAL	Baltimore Orioles	R	R	1989	+5.17550000000000e+04	marteal01	Alfredo Marte	1956711	Alfredo Marte	LF	+3.22510000000000e+04	Alfredo Marte	LF	5212	Alfredo Marte	marteal01	+9.35400000000000e+03	Alfredo Ma
8	+4.30580000000000e+05	Alfredo Simon	P	CIN	Cincinnati Reds	R	R	1981	+4.55810000000000e+04	simonal01	Alfredo Simon	448968	Alfredo Simon	SP	+2.86990000000000e+04	Alfredo Simon	SP	2155	Alfredo Simon	simonal01	+7.97500000000000e+03	Alfredo Sim
9	+4.55378000000000e+05	Ali Solis	C	LAD	Los Angeles Dodgers	R	R	1987	+5.23620000000000e+04	solisal01	Ali Solis	1946524	Ali Solis	C	+3.21140000000000e+04	Ali Solis	C	8848	Ali Solis	solisal01	+9.30400000000000e+03	Ali Solis
10	+4.88852000000000e+05	Allan Dykstra	1B	TB	Tampa Bay Rays	L	R	1987	+5.78130000000000e+04	dykstal01	Allan Dykstra	1960245	Allan Dykstra	1B	+3.23610000000000e+04	Allan Dykstra	1B	9113	Allan Dykstra		+9.92200000000000e+03	Allan Dyks

Congratulations!! You have successfully completed this lab