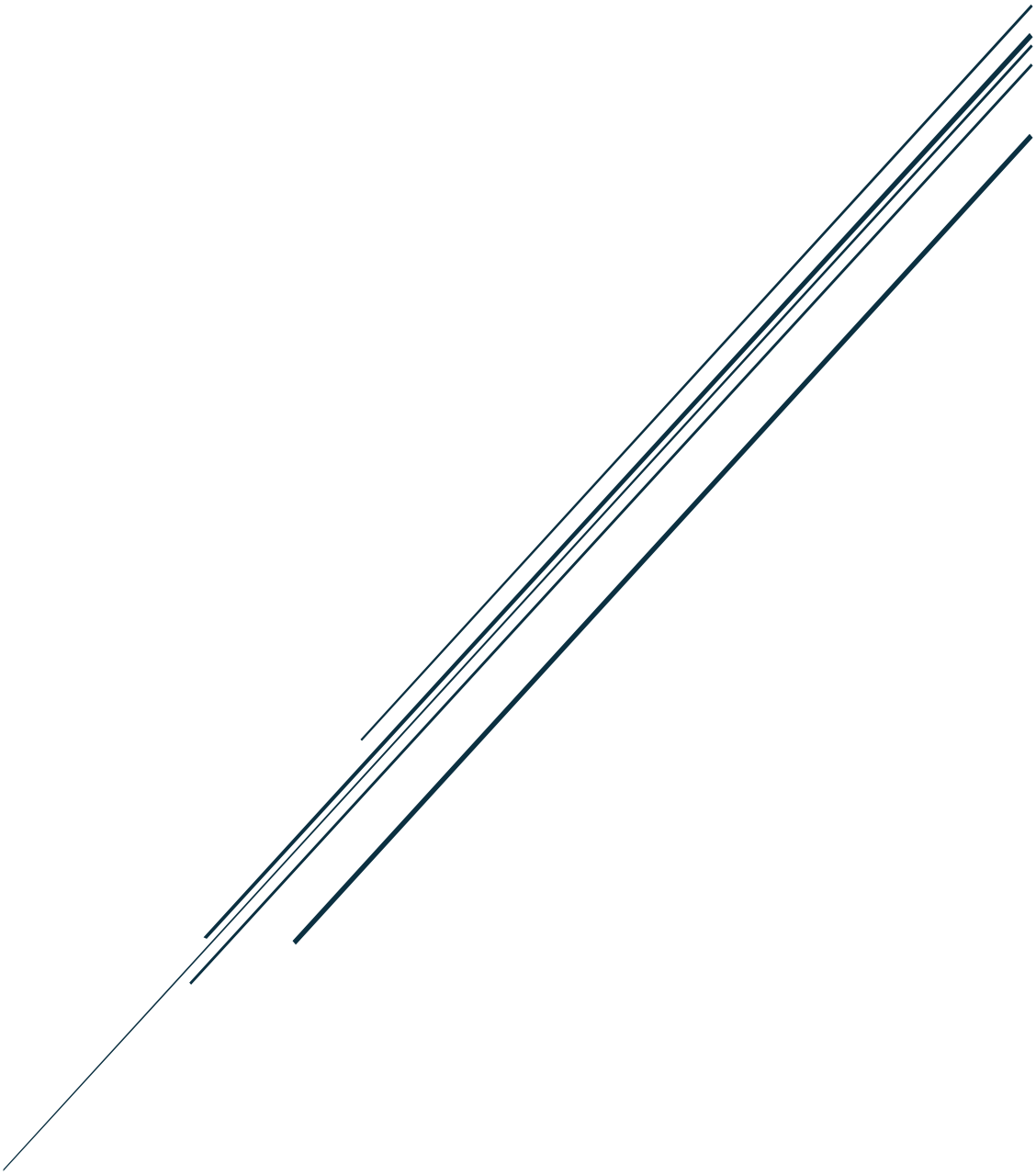
# Media Stream Analytics (Real-Time Intelligence For Media Decisions)

Project Report

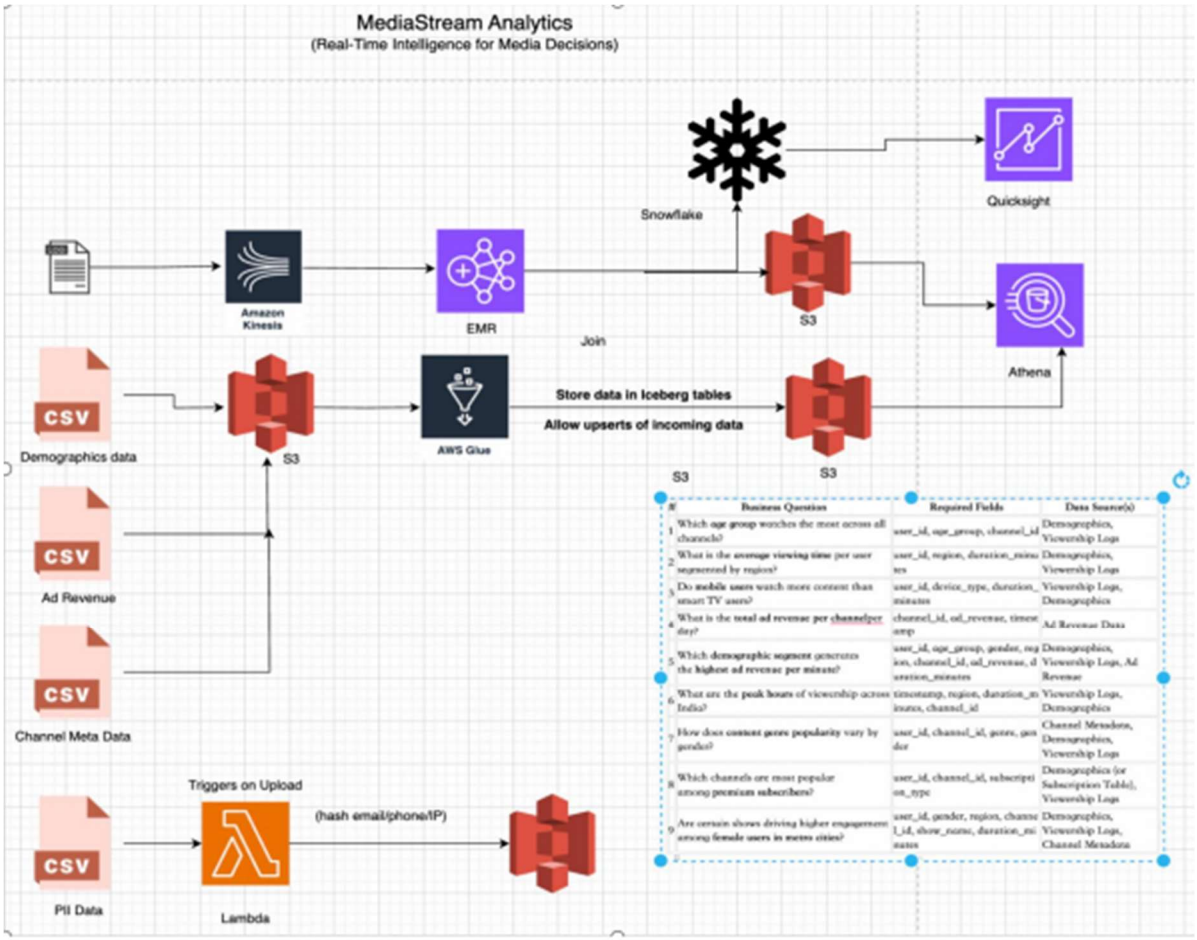


By
**Aahash Kamble**

**Problem Statement:**

The Media Stream Analytics project aims to address the growing need for real-time and batch analytics in the media industry by leveraging scalable cloud-based big data technologies. With the increasing volume of viewership data, ad revenue metrics, and user demographics, media companies require a robust solution to extract actionable insights that can drive programming decisions, optimize ad placements, and enhance user engagement.

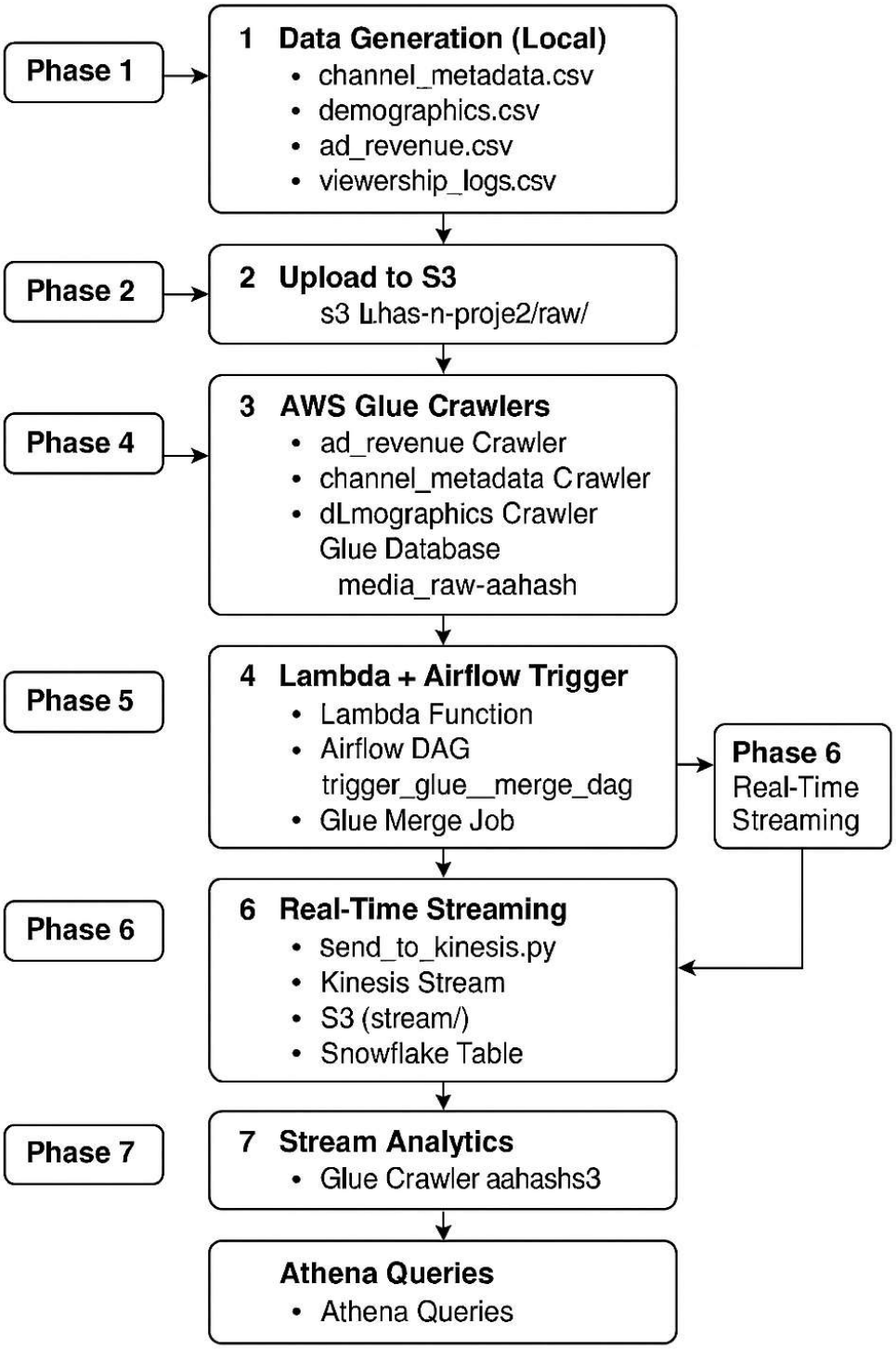
**Data Flow Architecture:**




**Key Technologies Used**

- **AWS Services**: S3, Glue, Lambda, EMR, Kinesis, Athena, MWAA
- **Data Formats**: CSV, Iceberg, Parquet
- **Processing Engines**: Spark (Batch & Streaming)
- **Analytics**: Athena SQL, Snowflake
- **Automation**: Airflow DAGs, Lambda triggers

# Flow of Media Stream Analytics (Real-Time Intelligence for Media Decisions)



## PHASE 1: DATA GENERATION (LOCAL)

vi generate_media_data.py

python3 generate_media_data.py

This creates the following CSV files:

- channel_metadata.csv
- demographics.csv
- ad_revenue.csv
- viewership_logs.csv

Code:

```
import csv
import random
from datetime import datetime, timedelta

# ----------------------------
# Global Lists and Mappings
# ----------------------------
CHANNEL_NAMES = [
    "Star Plus", "Colors TV", "Sony Entertainment Television", "Zee TV", "Star Bharat",
    "Sony SAB", "Dangal TV", "Zee Anmol", "Colors Rishtey", "DD National",
    "Star Sports 1", "Star Sports 2", "Star Sports 3", "Star Sports Select 1", "Star Sports Select 2",
    "Sony Sports Ten 1", "Sony Sports Ten 2", "Sony Sports Ten 3", "DD Sports", "Eurosport India",
    "Aaj Tak", "ABP News", "India TV", "News18 India", "Republic Bharat",
    "Times Now", "CNN-News18", "NDTV India", "Zee News", "India Today",
    "Sun TV", "Star Vijay", "Colors Tamil", "Zee Tamil", "KTV",
    "Star Maa", "Zee Telugu", "ETV Telugu", "Gemini TV", "Asianet",
    "Surya TV", "Zee Kannada", "Colors Kannada", "Zee Marathi", "Zee Bangla",
    "ETV Marathi", "DD Sahyadri", "DD Bangla", "News18 Kerala", "News18 Tamil Nadu"
]

GENRES = ["Entertainment", "News", "Sports", "Kids", "Music", "Movies"]
LANGUAGES = ["Hindi", "English", "Tamil", "Telugu", "Malayalam", "Kannada", "Marathi", "Bengali"]
REGIONS = ["North", "South", "East", "West", "Central", "Northeast", "Pan-India"]
DEVICES = ["Mobile", "Tablet", "Smart TV", "Laptop"]
PLATFORMS = ["Android", "iOS", "Web", "FireTV", "Roku"]

CHANNEL_ATTRIBUTES = {
    # genre, language pairs
    "Star Sports 1": ("Sports", "Hindi"), "Sony Sports Ten 1": ("Sports", "English"),
    "DD Sports": ("Sports", "Hindi"), "Star Plus": ("Entertainment", "Hindi"),
    "Sony Entertainment Television": ("Entertainment", "Hindi"), "Zee TV": ("Entertainment", "Hindi"),
    "Colors TV": ("Entertainment", "Hindi"), "SAB TV": ("Entertainment", "Hindi"),
    "Aaj Tak": ("News", "Hindi"), "NDTV India": ("News", "English"),
    "Republic Bharat": ("News", "Hindi"), "Sun TV": ("Entertainment", "Tamil"),
    "ETV Telugu": ("Entertainment", "Telugu"), "Asianet": ("Entertainment", "Malayalam"),
    "Colors Marathi": ("Entertainment", "Marathi"), "Zee Bangla": ("Entertainment", "Bengali"),
```

```
    "Times Now": ("News", "English"), "CNN-News18": ("News", "English"),
    "Zee News": ("News", "Hindi"), "ABP News": ("News", "Hindi"),
    "Star Vijay": ("Entertainment", "Tamil"), "KTV": ("Movies", "Tamil"),
}

# ----------------------------
# Dataset Generators
# ----------------------------

def generate_channel_metadata():
    print("Writing channel meta data......")
    channel_metadata = []
    channel_id_map = {}
    for i, name in enumerate(CHANNEL_NAMES):
        channel_id = f"CH{i+1:03d}"
        genre, language = CHANNEL_ATTRIBUTES.get(name, (random.choice(GENRES),
random.choice(LANGUAGES)))
        launch_year = random.randint(2000, 2022)
        channel_metadata.append([channel_id, name, genre, language, launch_year])
        channel_id_map[name] = channel_id
    with open("channel_metadata.csv", "w", newline='') as f:
        writer = csv.writer(f)
        writer.writerow(["channel_id", "channel_name", "genre", "language", "launch_year"])
        writer.writerows(channel_metadata)
    print("Writing channel meta data completed ......")
    return channel_id_map

def generate_demographics(num_users=5000):
    demographics = []
    user_ids = set()
    for _ in range(num_users):
        user_id = f"U{10000 + random.randint(0, 49999)}"
        gender = random.choice(["Male", "Female", "Other"])
        age_group = random.choice(["<18", "18-25", "26-35", "36-45", "46-60", "60+"])
        region = random.choice(REGIONS)
        subscription_type = random.choice(["Free", "Basic", "Premium"])
        demographics.append([user_id, gender, age_group, region, subscription_type])
        user_ids.add(user_id)
    with open("demographics.csv", "w", newline='') as f:
        writer = csv.writer(f)
        writer.writerow(["user_id", "gender", "age_group", "region", "subscription_type"])
        writer.writerows(demographics)
    return user_ids

def generate_ad_revenue(channel_id_map, days=7):
    ad_revenue = []
    for name, cid in channel_id_map.items():
        for i in range(days):
            date = (datetime.now() - timedelta(days=i)).strftime('%Y-%m-%d')
            revenue = round(random.uniform(10000, 100000), 2)
            ad_revenue.append([cid, name, date, revenue])
    with open("ad_revenue.csv", "w", newline='') as f:
```

```
        writer = csv.writer(f)
        writer.writerow(["channel_id", "channel_name", "date", "ad_revenue"])
        writer.writerows(ad_revenue)

def generate_viewership_logs(channel_id_map, user_ids, num_records=10000):
    logs = []
    start_time = datetime.now() - timedelta(days=7)
    user_id_list = list(user_ids)
    for _ in range(num_records):
        user_id = random.choice(user_id_list)
        channel_name = random.choice(CHANNEL_NAMES)
        channel_id = channel_id_map[channel_name]
        timestamp = start_time + timedelta(seconds=random.randint(0, 604800))
        duration = random.randint(1, 180)
        region = random.choice(REGIONS)
        subscription = random.choice(["Free", "Basic", "Premium"])
        device = random.choice(DEVICES)
        platform = random.choice(PLATFORMS)
        is_live = random.choice([True, False])
        genre = CHANNEL_ATTRIBUTES.get(channel_name, (random.choice(GENRES),))[0]
        ads_watched = random.randint(0, 5)
        ad_revenue = round(ads_watched * random.uniform(10, 200), 2)
        engagement = round(random.uniform(0.2, 1.0), 2)
        buffer_count = random.randint(0, 3)
        completion_pct = round(random.uniform(20, 100), 2)
        session_id = f"SID{random.randint(100000, 999999)}"
        show_name = f"Show_{random.randint(1, 200)}"
        logs.append([
            session_id, user_id, channel_id, channel_name, show_name, genre, timestamp.strftime('%Y-%m-%d
%H:%M:%S'),
            duration, region, subscription, device, platform, is_live, ads_watched, ad_revenue,
            engagement, buffer_count, completion_pct
        ])
    with open("viewership_logs.csv", "w", newline='') as f:
        writer = csv.writer(f)
        writer.writerow([
            "session_id", "user_id", "channel_id", "channel_name", "show_name", "genre", "timestamp",
            "duration_minutes", "region", "subscription_type", "device", "platform", "is_live",
            "ads_watched", "ad_revenue", "engagement_score", "buffer_count", "completion_percentage"
        ])
        writer.writerows(logs)

# ----------------------------
# Master Execution
# ----------------------------
if __name__ == "__main__":
    channel_id_map = generate_channel_metadata()
    user_ids = generate_demographics()
    generate_ad_revenue(channel_id_map)
    generate_viewership_logs(channel_id_map, user_ids, num_records=10000)  # Adjust as needed
```

## PHASE 2: UPLOAD FILES TO S3

### Step 2: Create S3 folder structure

Target bucket: s3://Aahash-project2

aahash-project2/

└── raw/

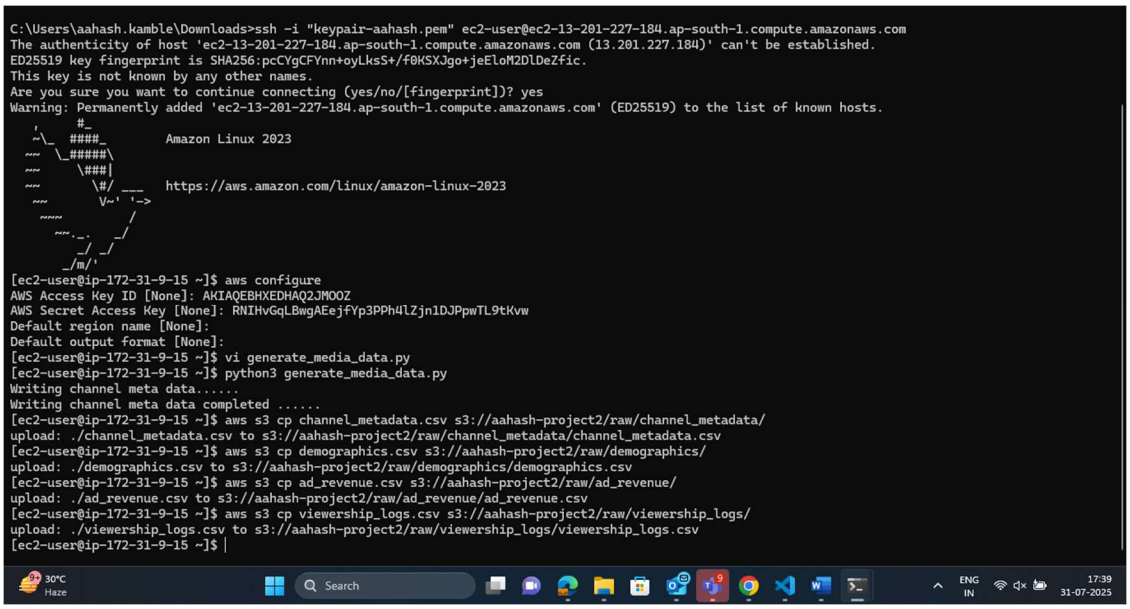
  ├── channel_metadata/

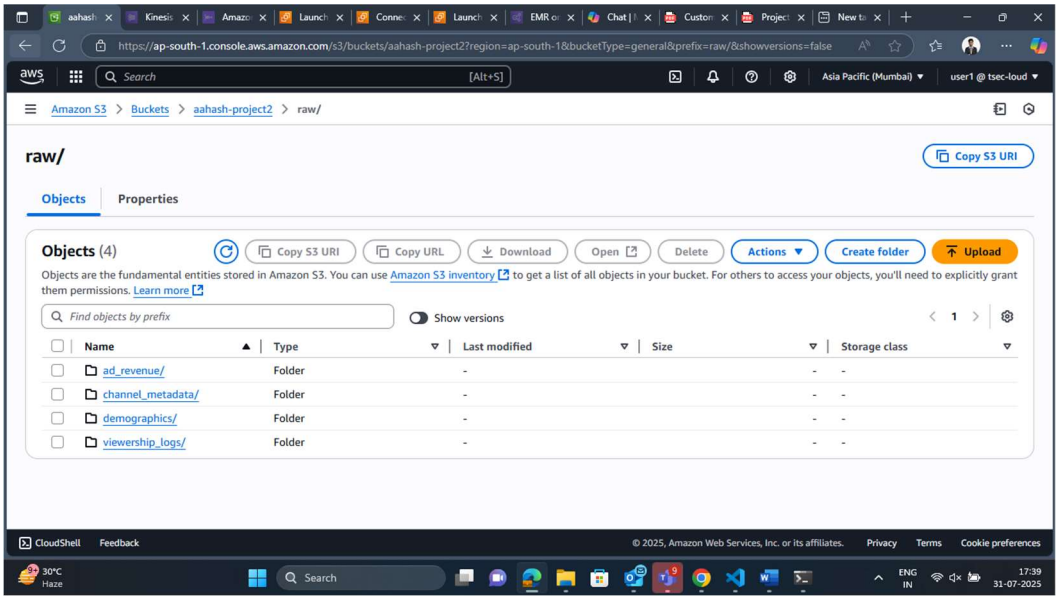
  ├── demographics/

  ├── ad_revenue/

  └── viewership_logs/

Step 3: Upload the files to bucket



## PHASE 3: AWS Glue Crawler Setup – Media Stream Analytics

Created Glue Database:

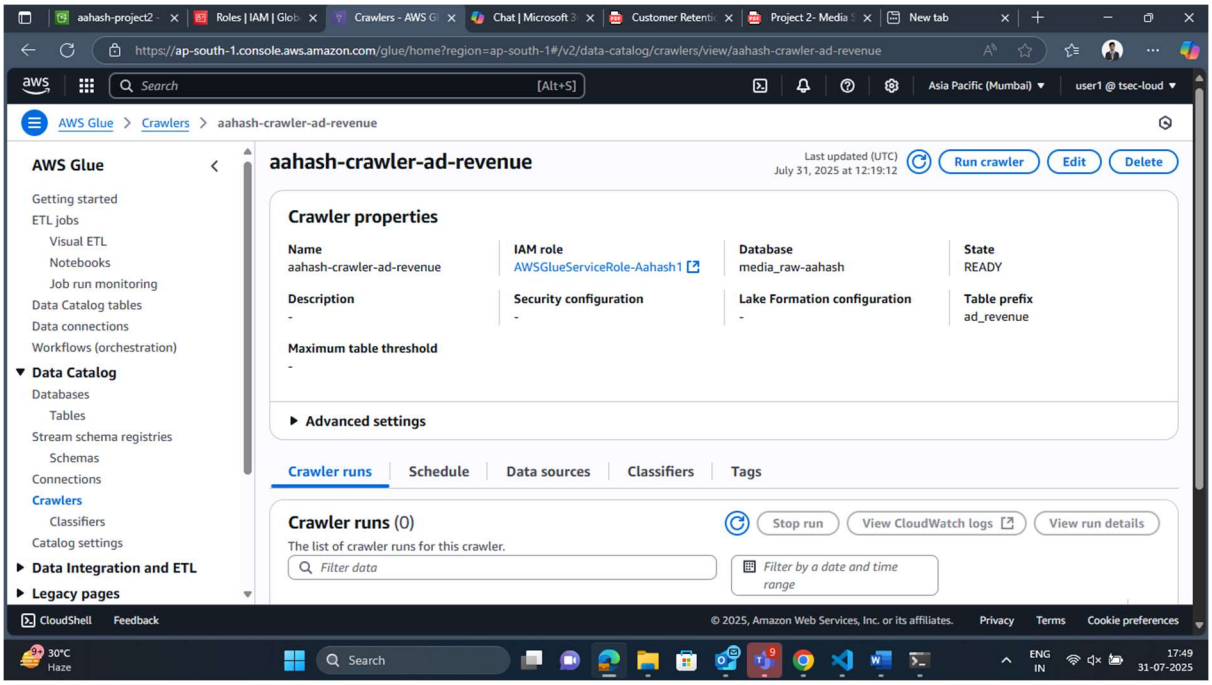
### Glue Database

- Name: media_raw-aahash

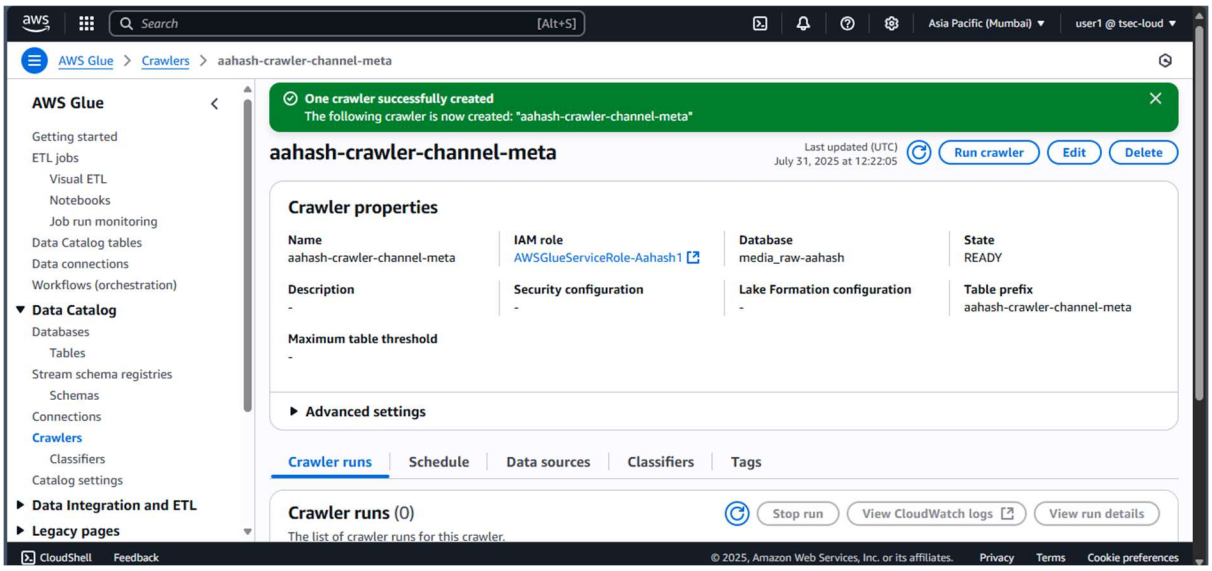
### Steps to Create Glue Crawlers for 3 csv

For each dataset:

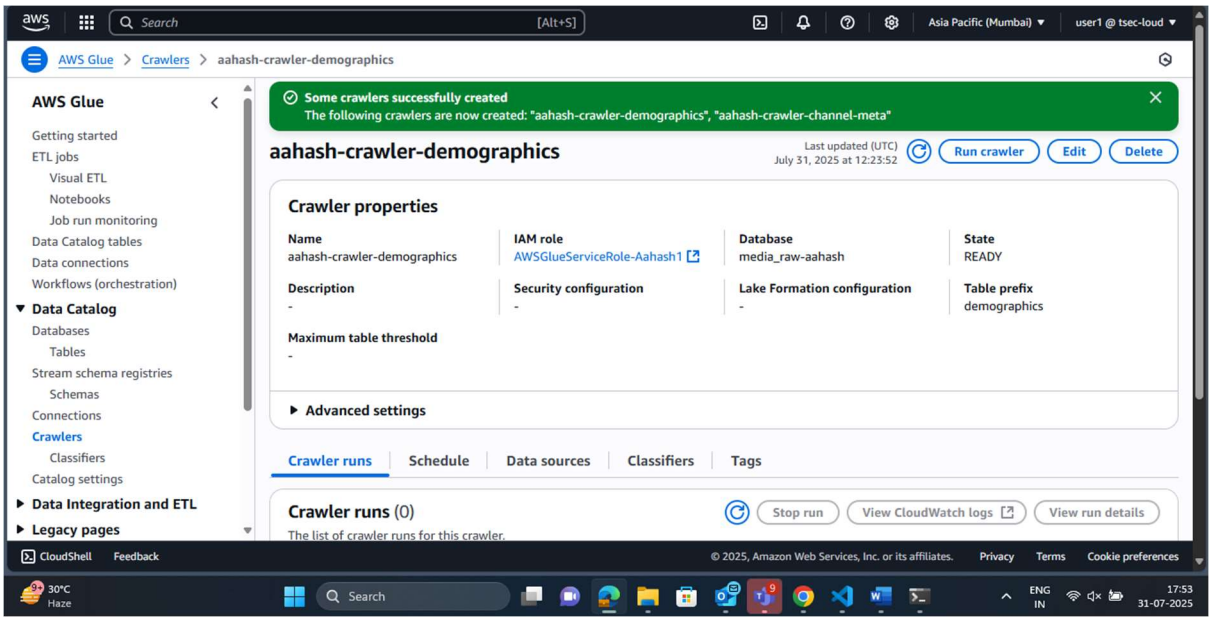
### Crawler 1: aahash-crawler-ad-revenue




### Crawler 2: aahash-crawler-channel-meta

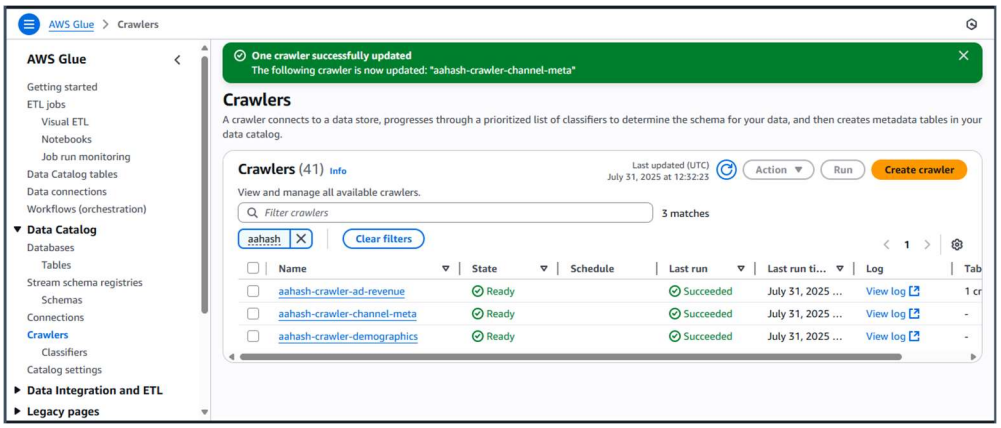



### Crawler 3: aahash-crawler-demographics

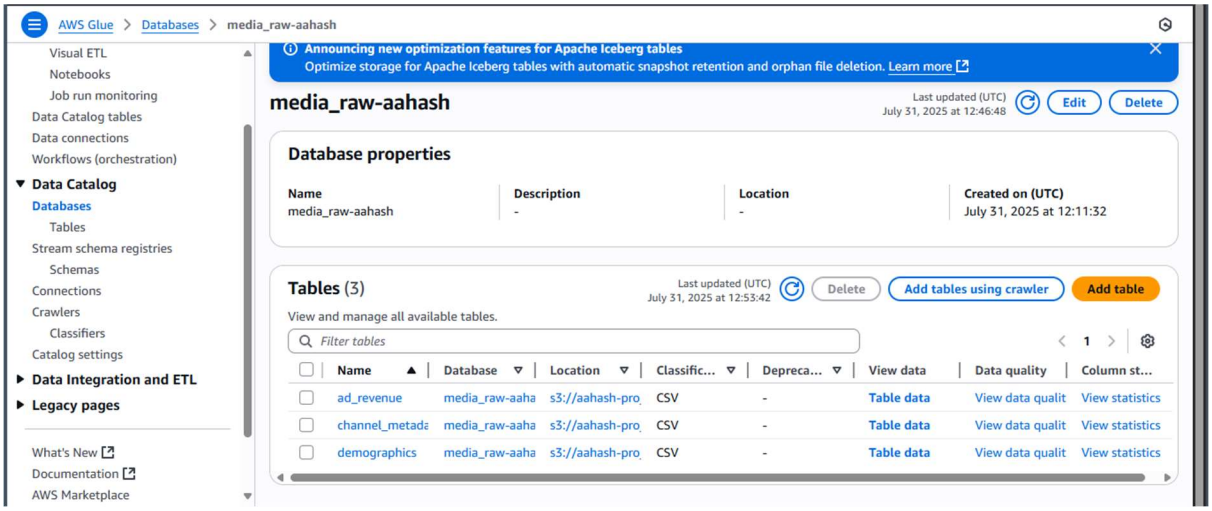



**After creating all 3 crawlers:**

1. I have Run each crawler manually from the Glue Console.




2. Verified the tables are created in the **media_raw-aahash** Glue database.



## PHASE 4: Transform & Write to Iceberg Format (Ad Revenue, Channel Metadata, Demographics)

Transform raw CSV data from S3 and write it to Iceberg-format tables stored in **S3** using **AWS Glue**, with **schema evolution and ACID support**.

**Raw Data Location (Input):**

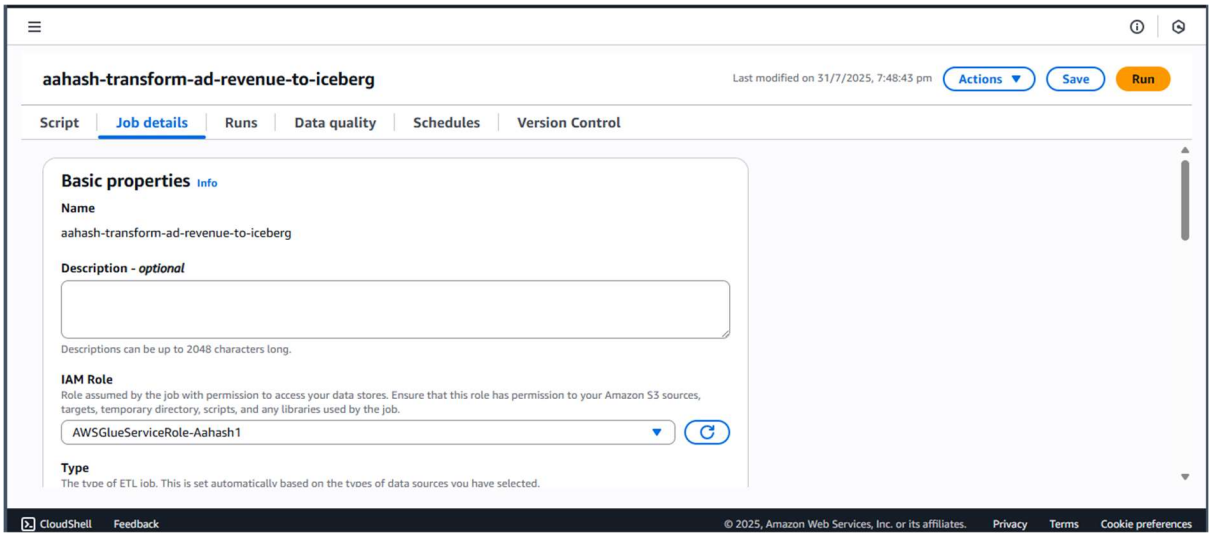
All from bucket: s3://aahash-project2/media/raw/

- ad_revenue/
- channel_metadata/
- demographics/

AWS Glue Studio (ETL jobs in Spark)
Apache Iceberg (table format)
AWS Glue Data Catalog (catalog for Iceberg tables)
S3 (aahash-project2/media/iceberg/) as Iceberg storage

**Target Folder Structure**
Output Iceberg tables go here:
s3://aahash-project2/media/iceberg/ad_revenue/
s3://aahash-project2/media/iceberg/channel_metadata/
s3://aahash-project2/media/iceberg/demographics/

Step 1: Created a New Glue ETL Job for all ad_revenue, channel_metadata/ demographics/

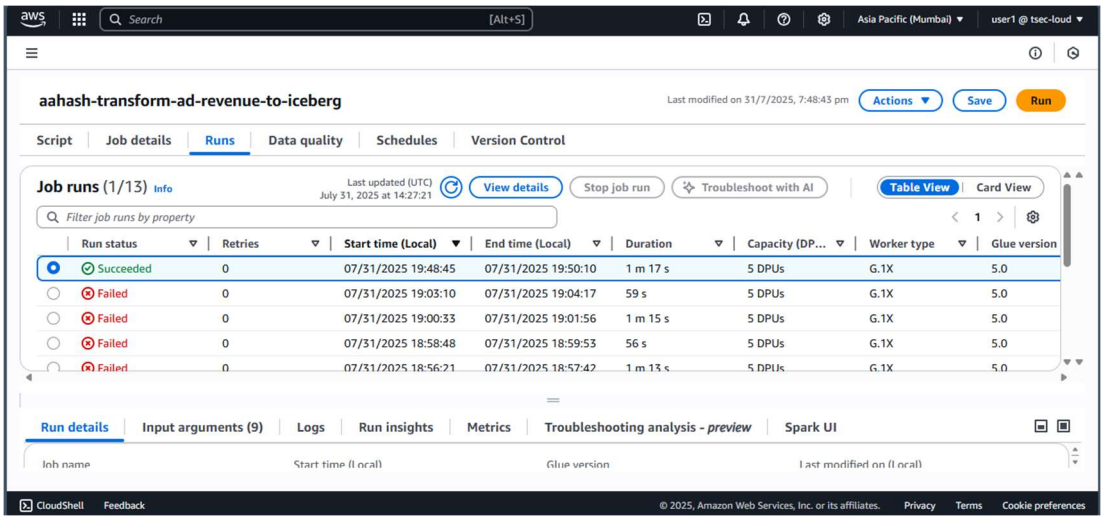



Step 2: Script for Iceberg Transformation

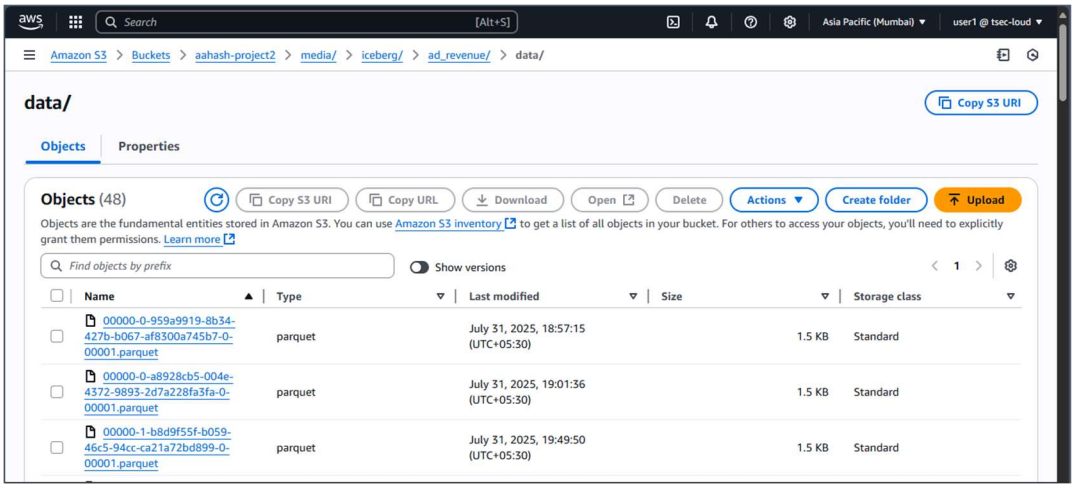
```
import sys
from pyspark.context import SparkContext
from awsglue.context import GlueContext
from awsglue.utils import getResolvedOptions
from awsglue.job import Job
from pyspark.sql import SparkSession

# Accept JOB_NAME as argument
```

```
args = getResolvedOptions(sys.argv, ['JOB_NAME'])

# Initialize contexts ONCE
sc = SparkContext()
glueContext = GlueContext(sc)
spark = glueContext.spark_session
job = Job(glueContext)
job.init(args['JOB_NAME'], args)

# Set Iceberg-specific configurations
spark.conf.set("spark.sql.catalog.glue_catalog", "org.apache.iceberg.spark.SparkCatalog")
spark.conf.set("spark.sql.catalog.glue_catalog.catalog-impl", "org.apache.iceberg.aws.glue.GlueCatalog")
spark.conf.set("spark.sql.catalog.glue_catalog.warehouse", "s3://aahash-project2/media/iceberg/")
spark.conf.set("spark.sql.catalog.glue_catalog.io-impl", "org.apache.iceberg.aws.s3.S3FileIO")

# Load raw tables from Glue Data Catalog
try:
    # Load and transform ad_revenue data
    ad_revenue_raw = spark.table("`media_raw-aahash`.ad_revenue")
    ad_revenue_df = ad_revenue_raw.withColumn("date", ad_revenue_raw["date"].cast("date"))
    print(f"Ad revenue columns: {ad_revenue_df.columns}")

    # Load channel metadata
    channel_metadata_df = spark.table("`media_raw-aahash`.channel_metadata")
    print(f"Channel metadata columns: {channel_metadata_df.columns}")

    # Load demographics and fix column names
    demographics_raw = spark.table("`media_raw-aahash`.demographics")
    print(f"Demographics raw columns: {demographics_raw.columns}")

    # Map generic column names to proper names
    # Assuming order: user_id, gender, age_group, region, subscription_type
    demographics_df = demographics_raw \
        .withColumnRenamed("col0", "user_id") \
        .withColumnRenamed("col1", "gender") \
        .withColumnRenamed("col2", "age_group") \
        .withColumnRenamed("col3", "region") \
        .withColumnRenamed("col4", "subscription_type")

    print(f"Demographics after renaming: {demographics_df.columns}")

    # Show sample to verify the mapping is correct
    print("Demographics sample data:")
    demographics_df.show(5)

    print("Successfully loaded and transformed source tables")
except Exception as e:
    print(f"Error loading source tables: {e}")
    raise
except Exception as e:
    print(f"Error loading source tables: {e}")
    raise

# Create Iceberg Database and Tables
try:
    # Create the database first
    print("Creating media_iceberg database...")
    create_db_sql = "CREATE DATABASE IF NOT EXISTS `glue_catalog`.`media_iceberg` LOCATION 's3://aahash-
project2/media/iceberg/'"
    spark.sql(create_db_sql)
    print("Database media_iceberg created/verified")

    # Create ad_revenue table
    print("Creating ad_revenue table...")
    ad_revenue_sql = """CREATE TABLE IF NOT EXISTS `glue_catalog`.`media_iceberg`.`ad_revenue` (
```

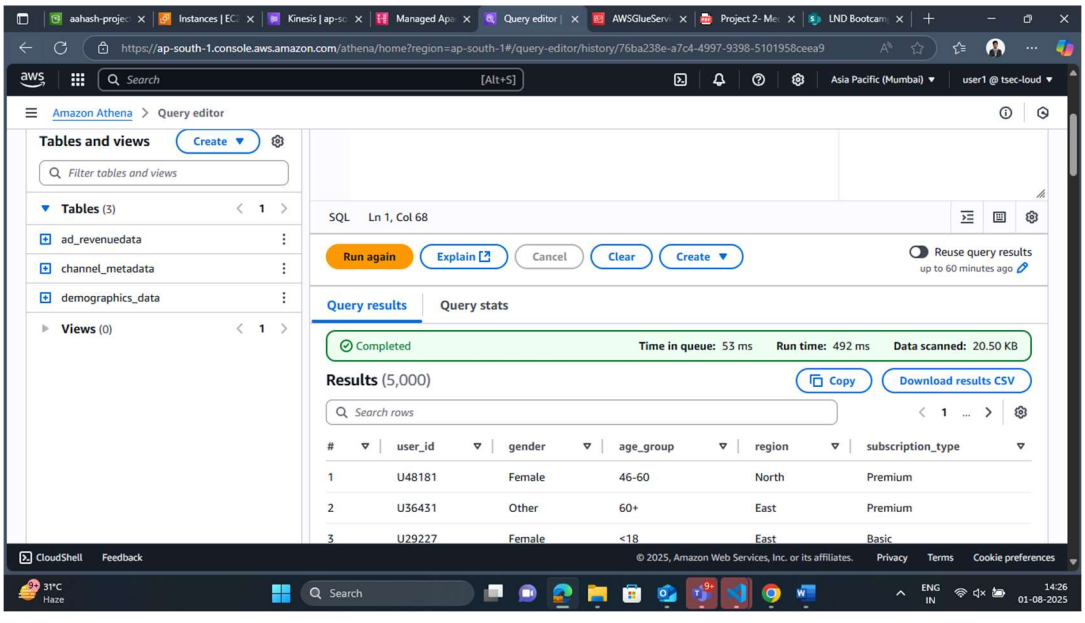
```
        channel_id STRING,
        channel_name STRING,
        date DATE,
        ad_revenue FLOAT
    ) USING iceberg LOCATION 's3://aahash-project2/media/iceberg/ad_revenue/"""
    spark.sql(ad_revenue_sql)
    print("Ad revenue table created/verified")

    # Create channel_metadata table
    print("Creating channel_metadata table...")
    channel_sql = """CREATE TABLE IF NOT EXISTS `glue_catalog`.`media_iceberg`.`channel_metadata` (
        channel_id STRING,
        channel_name STRING,
        genre STRING,
        language STRING,
        launch_year INT
    ) USING iceberg LOCATION 's3://aahash-project2/media/iceberg/channel_metadata/"""
    spark.sql(channel_sql)
    print("Channel metadata table created/verified")

    # Create demographics table
    print("Creating demographics table...")
    demographics_sql = """CREATE TABLE IF NOT EXISTS `glue_catalog`.`media_iceberg`.`demographics` (
        user_id STRING,
        gender STRING,
        age_group STRING,
        region STRING,
        subscription_type STRING
    ) USING iceberg LOCATION 's3://aahash-project2/media/iceberg/demographics/"""
    spark.sql(demographics_sql)
    print("Demographics table created/verified")
    print("All Iceberg tables created/verified successfully")

except Exception as e:
    print(f"Error creating Iceberg tables: {e}")
    raise

# Write DataFrames to Iceberg Tables
try:
    # Write ad_revenue data
    ad_revenue_df.writeTo("glue_catalog.media_iceberg.ad_revenue").using("iceberg").option("overwrite-mode",
"dynamic").tableProperty("format-version", "2").append()
    print("Ad revenue data written successfully")

    # Write channel_metadata data
    channel_metadata_df.writeTo("glue_catalog.media_iceberg.channel_metadata").using("iceberg").option("overwrite-mode",
"dynamic").tableProperty("format-version", "2").append()
    print("Channel metadata written successfully")

    # Write demographics data
    demographics_df.writeTo("glue_catalog.media_iceberg.demographics").using("iceberg").option("overwrite-mode",
"dynamic").tableProperty("format-version", "2").append()
    print("Demographics data written successfully")

except Exception as e:
    print(f"Error writing to Iceberg tables: {e}")
    raise

# Job Commit
print("Job completed successfully")
job.commit()
```




Data is generated and send to the bucket successfully




## Using Athena visualise the data of Iceberg



## Phase 5: Iceberg Table Update Trigger via Lambda & Airflow

Automatically trigger an **Airflow DAG** via **Lambda** when **Iceberg tables** (stored in S3 using Glue Catalog) are updated. The DAG will run a **Glue Job** to **merge or insert** the updated records.

Step 1: Prepare S3 Bucket Folder for DAGs, Plugins, Requirements

- **S3 Bucket**:
  Use your existing bucket aahash-project2.
- **Create folders**:
  s3://aahash-project2/airflow/
  ├── dags/
  ├── plugins/
  └── requirements.txt (optional)

Uploaded empty.py file in dags/ because it required for MWAA to start

### Step 2: Create MWAA Environment Setup

Environment Name: Aahash-iceberg

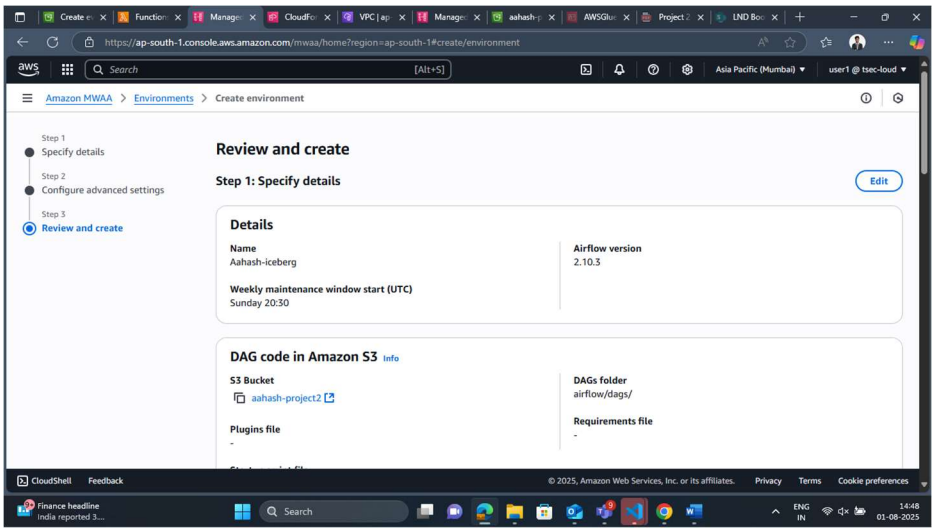
S3 Bucket: aahash-project2

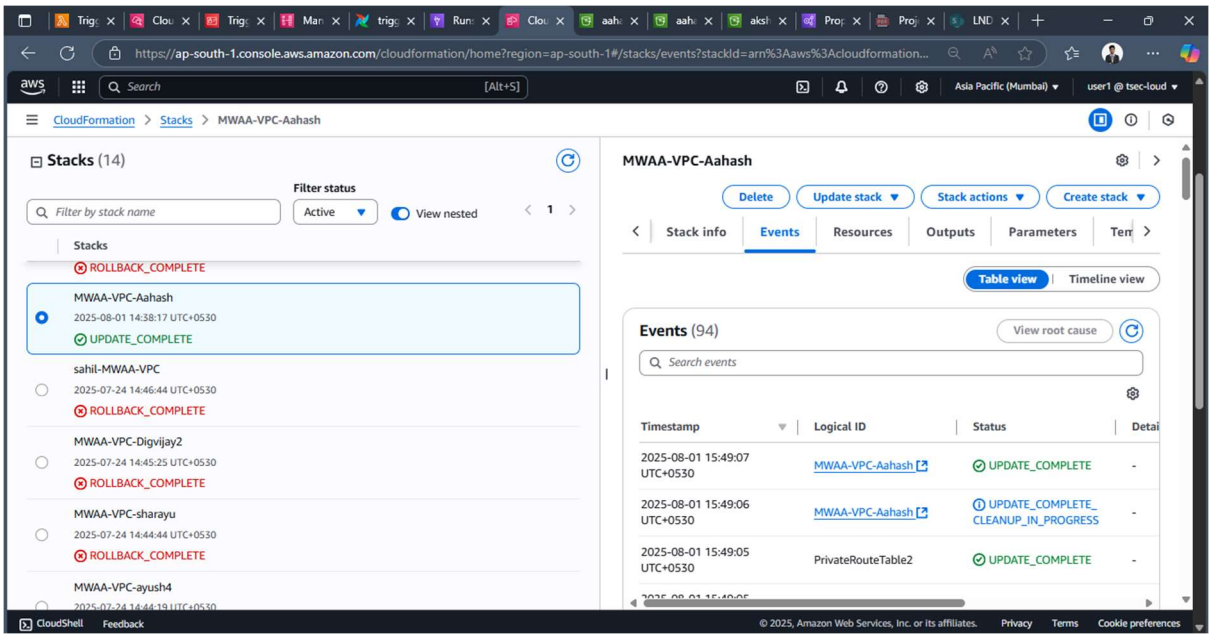
DAGs folder path: airflow/dags/

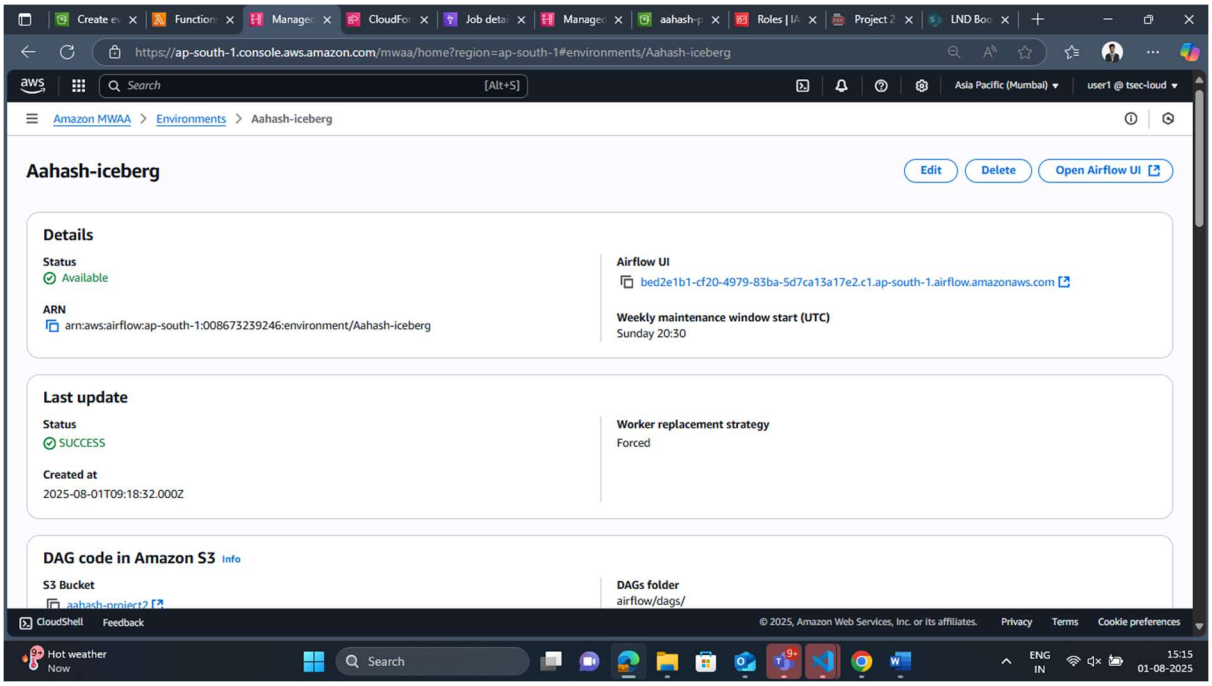
Airflow Version: 2.10.3

Execution Role: MWAAExecutionRole-Aahash

VPC and Subnets configured






## Step 2: Prepare DAG for Glue Trigger

```
from airflow import DAG
from airflow.providers.amazon.aws.operators.glue import GlueJobOperator
from datetime import datetime

default_args = {
    'owner': 'aahash',
    'start_date': datetime(2025, 1, 1),
    'retries': 0
}
```

```
with DAG(
    dag_id='trigger_glue_merge_dag',
    default_args=default_args,
    schedule_interval=None,
    catchup=False,
    description='Trigger Glue job for Iceberg table updates'
) as dag:

    trigger_glue_job = GlueJobOperator(
        task_id='run_glue_merge',
        job_name='iceberg_merge_job-Aahash',
        script_args={
            "--JOB_NAME": "iceberg_merge_job-Aahash"
        },
        region_name='ap-south-1',
        wait_for_completion=True
    )
```

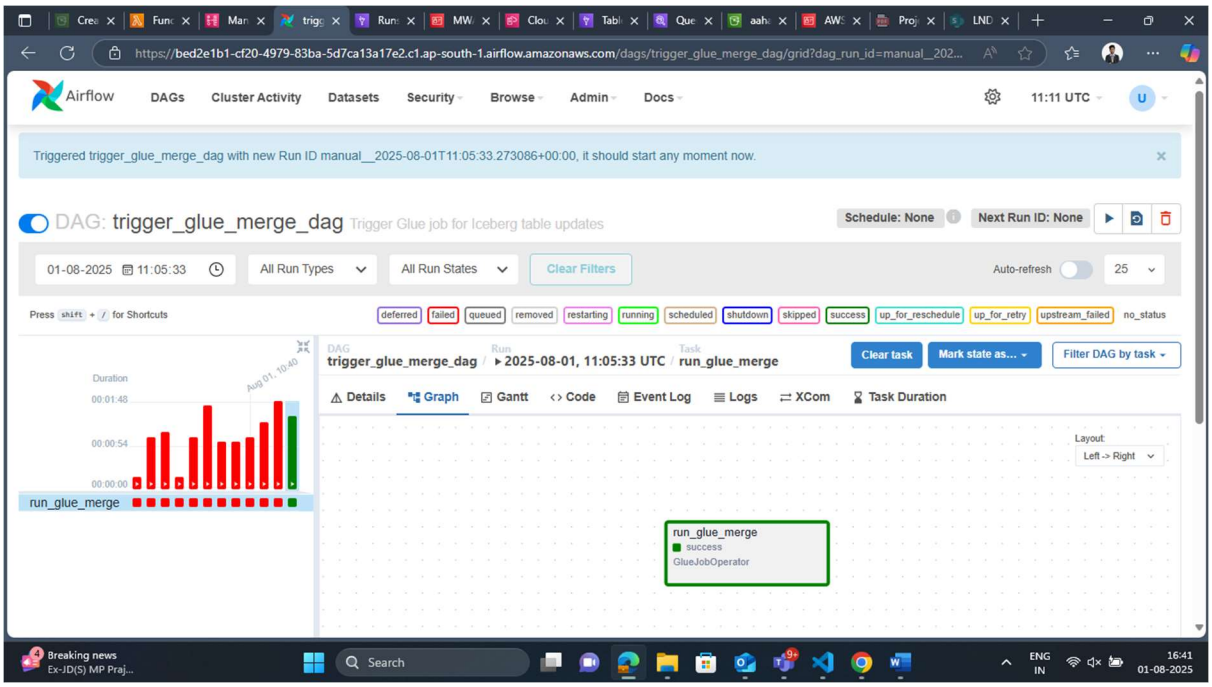
**Step3: Glue job run script**

```
from pyspark.sql import SparkSession
from pyspark.sql.functions import col, to_date

# Step 1: Initialize SparkSession with Iceberg configs
spark = SparkSession.builder \
    .appName("Glue Iceberg Table CDC") \
    .config("spark.sql.catalog.glue_catalog", "org.apache.iceberg.spark.SparkCatalog") \
    .config("spark.sql.catalog.glue_catalog.catalog-impl", "org.apache.iceberg.aws.glue.GlueCatalog")
\
    .config("spark.sql.catalog.glue_catalog.warehouse", "s3://aahash-project2/media/iceberg/") \
    .config("spark.sql.catalog.glue_catalog.io-impl", "org.apache.iceberg.aws.s3.S3FileIO") \
    .getOrCreate()

# Step 2: Create Iceberg table (only first time)
spark.sql("""
CREATE TABLE IF NOT EXISTS glue_catalog.media_iceberg.ad_revenuedata (
    channel_id STRING,
    channel_name STRING,
    date DATE,
    ad_revenue DOUBLE
)
USING ICEBERG
PARTITIONED BY (date)
""")
```

```
# Step 3: Read source CSV
df = spark.read.option("header", True).option("inferSchema", True).csv("s3://aahash-project2/raw/ad_revenue/ad_revenue.csv")

# Step 4: Transform
df = df.withColumn("date", to_date("date", "dd-MM-yyyy")) \
       .withColumn("ad_revenue", col("ad_revenue").cast("double"))

# Step 5: Register temporary view
df.createOrReplaceTempView("updates")

# Step 6: Perform MERGE into Iceberg table
spark.sql("""
MERGE INTO glue_catalog.media_iceberg.ad_revenuedata AS target
USING updates AS source
ON target.channel_id = source.channel_id AND target.date = source.date
WHEN MATCHED THEN UPDATE SET *
WHEN NOT MATCHED THEN INSERT *
""")
```

**Step 4: Run the Airflow**

Glue job name: iceberg_merge_job-Aahash

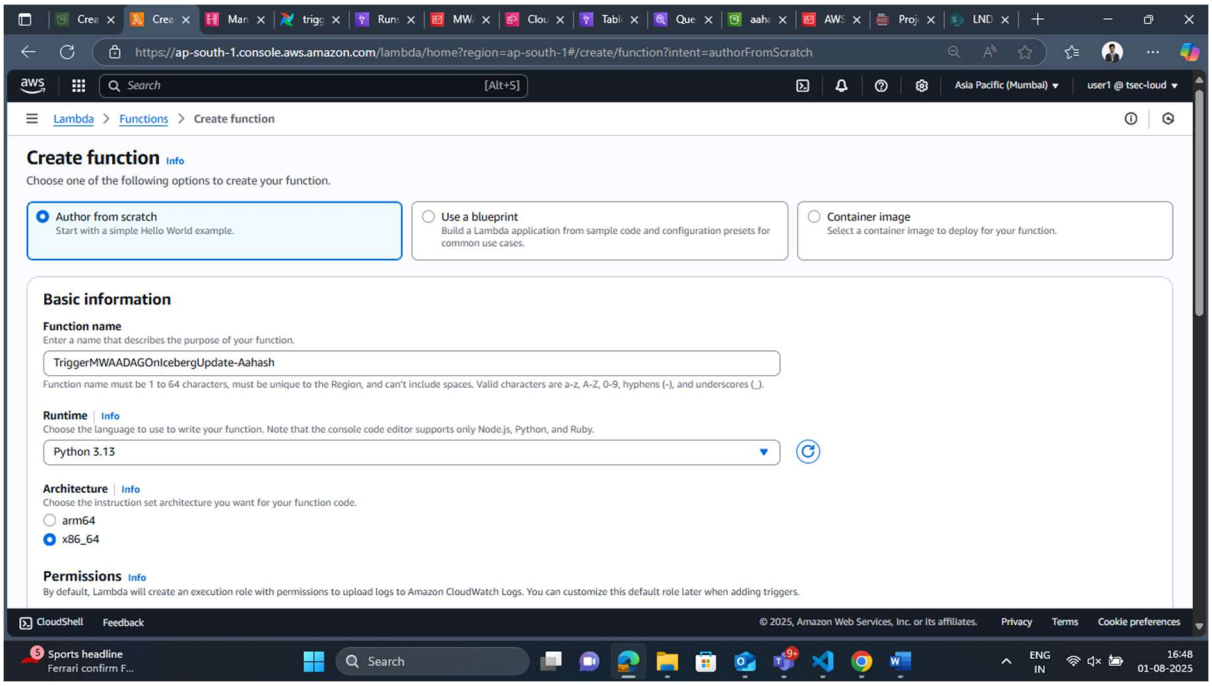



**Step 5: Create the Lambda Function**

🔧 **Configuration:**

- **Name**: TriggerMWAADAGOnIcebergUpdate
- **Runtime**: Python 3.10

- **IAM Role**: Create or attach a role with:
    - AmazonMWAAFullAccess
    - AmazonS3ReadOnlyAccess
    - CloudWatchLogsFullAccess

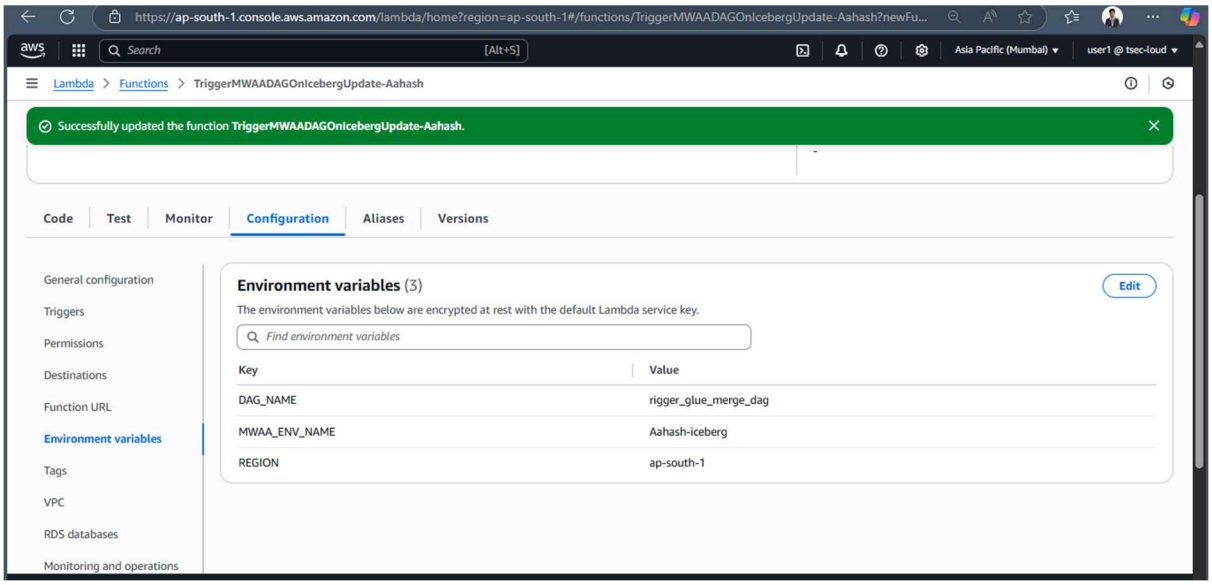



Environment Variables:

MWAA_ENV_NAME : Aahash-iceberg

REGION ap-south-1

DAG_NAME trigger_glue_on_iceberg_update



Lambda Code (Python):

```
import json
import boto3
import requests
from urllib.parse import urljoin

def lambda_handler(event, context):
    mwaa_env_name = "Aahash-iceberg"
    dag_name = "trigger_glue_merge_dag"

    # Step 1: Create MWAA client
    client = boto3.client('mwaa')

    # Step 2: Get CLI token & webserver hostname
    resp = client.create_cli_token(Name=mwaa_env_name)
    token = resp['CliToken']
    webserver_hostname = resp['WebServerHostname']

    # Step 3: Trigger DAG using MWAA CLI
    dag_trigger_cmd = f"dags trigger {dag_name}"

    url = f"https://{webserver_hostname}/aws_mwaa/cli"
    headers = {
        'Authorization': f"Bearer {token}",
        'Content-Type': 'text/plain'
    }

    mwaa_response = requests.post(
        url,
        headers=headers,
        data=dag_trigger_cmd.encode('utf-8')
    )

    print("Lambda triggered with the following event:")
    print(json.dumps(event, indent=4))
    print("DAG trigger response:")
    print(mwaa_response.text)

    return {
        'statusCode': 200,
        'body': 'Triggered MWAA DAG from Lambda'
    }
```

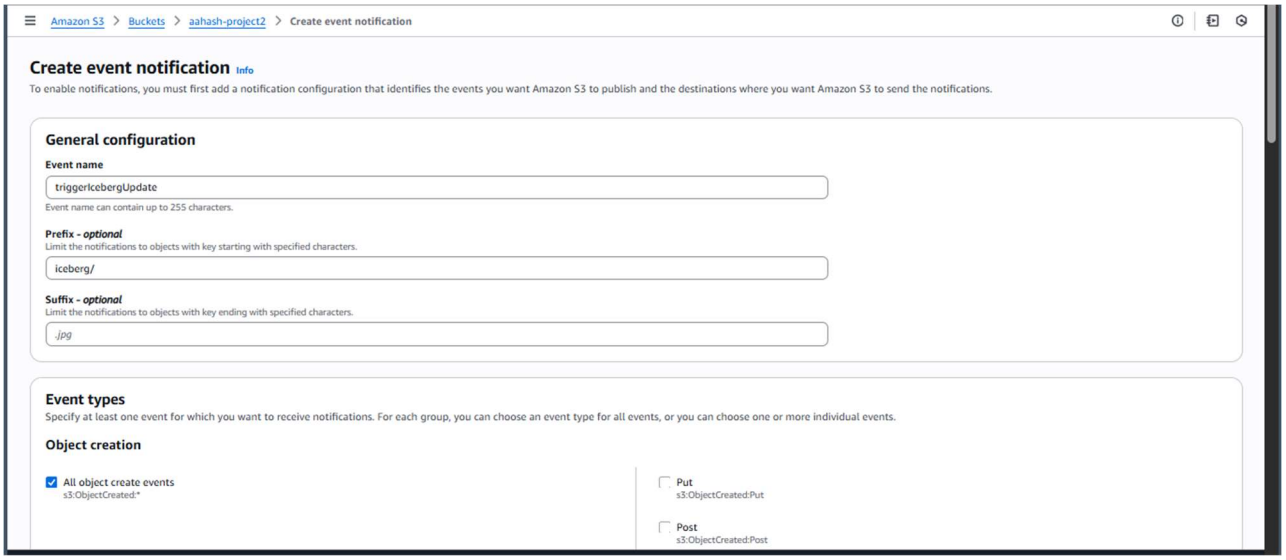
**Step 6: Add S3 Event Notification**

Go to the **S3 bucket**: aahash-project2

➤ **Configure an event like this:**

- **Name**: iceberg-put-trigger
- **Event type**: PUT
- **Prefix**: iceberg/
- **Send to**: Lambda function
- **Select function**: TriggerMWAADAGOnIcebergUpdate-Aahash

📌 This will trigger the Lambda whenever a file is added/updated inside the iceberg/ folder.




**Now lest test the Iceberg Table Update Trigger via Lambda & Airflow:**

- Uploading a new version of the file (overwrite/append),
- Or uploading a new partition/file to the same S3 path.

Upload a new file (or overwrite an existing one) to the S3 path of your Iceberg table, e.g.:

aws s3 cp updated_ad_revenue.csv s3://aahash-project2/ad_revenuedata/

This should trigger the **S3 event notification**, which invokes your **Lambda function**.

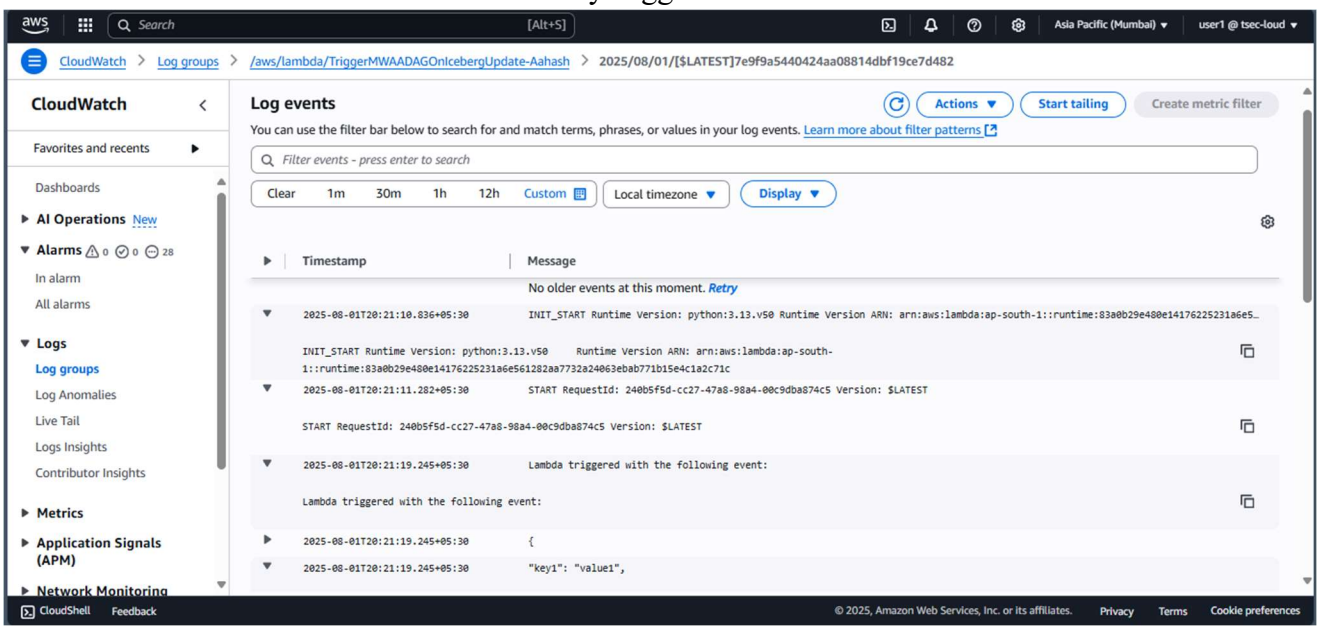
Modify the Parquet File: created file.py for making chnages

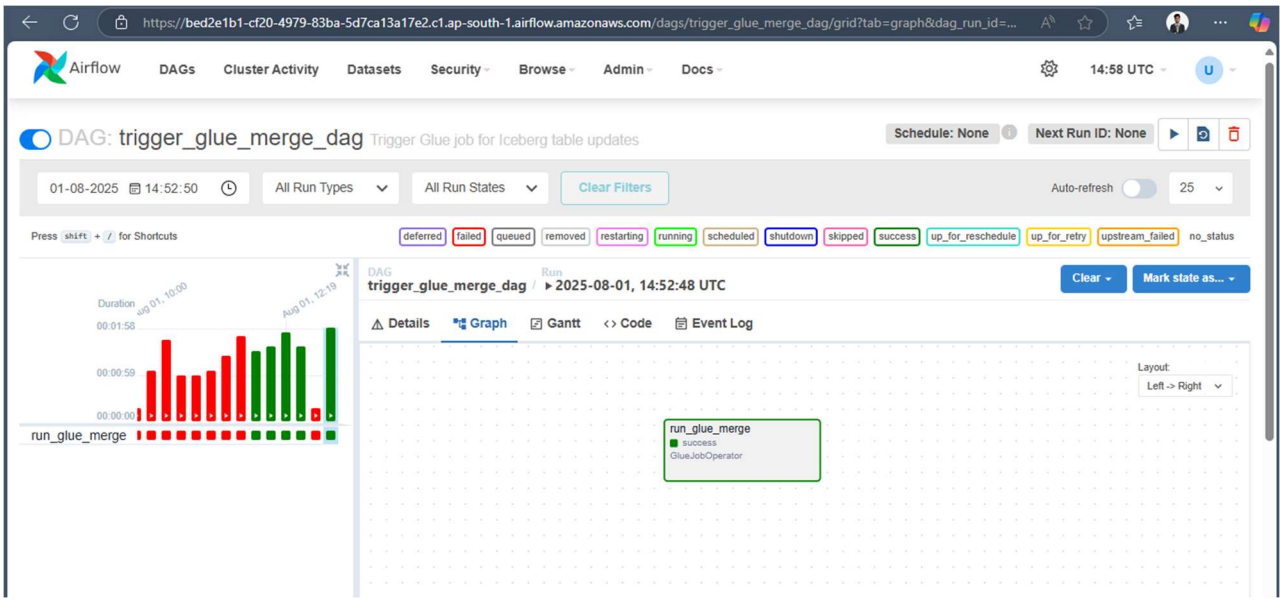
```
ec2-user@ip-172-31-19-204:~
import pandas as pd

# Load original file
df = pd.read_parquet("00000-6-4244a253-125e-4207-82fc-9d9e7a4c0f32-0-00001.parquet")

# Modify something - Example: Add 1 to ad_revenue
if "ad_revenue" in df.columns:
    df["ad_revenue"] += 1
else:
    df["ad_revenue"] = 999.99  # dummy column if not found

# Save modified version
df.to_parquet("modified_trigger_file.parquet", index=False)

print("Parquet file modified and saved as modified_trigger_file.parquet")

~
~
~
~
~
```

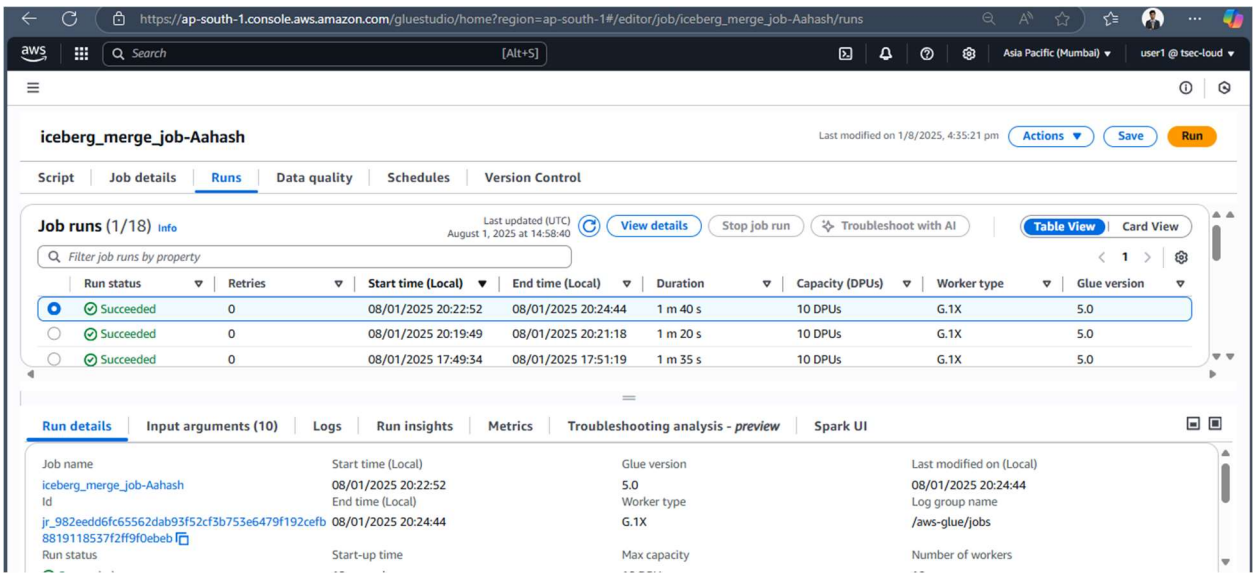
**Upload Modified File with New Name**

aws s3 cp modified_trigger_file.parquet s3://Aahash project2/media/iceberg/ad_revenue/data/trigger_file.parquet

Uploaded modified .parquet to trigger path
Verified CloudWatch logs:
Lambda execution started
File name and bucket printed
MWAA CLI token retrieved
DAG trigger initiated
Checked Airflow UI → DAG was successfully triggered



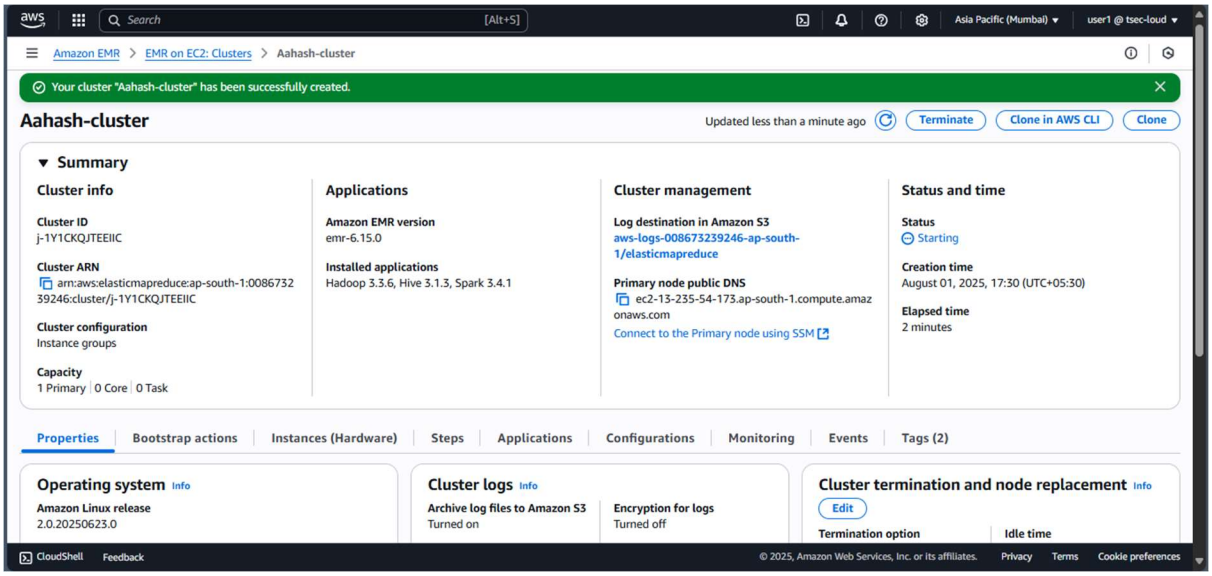

https://bed2e1b1-cf20-4979-83ba-5d7ca13a17e2.c1.ap-south-1.airflow.amazonaws.com/dags/trigger_glue_merge_dag/grid?tab=graph&dag_run_id=...
Airflow
DAGs
Cluster Activity
Datasets
Security
Browse
Admin
Docs
14:58 UTC
DAG: trigger_glue_merge_dag
Trigger Glue job for Iceberg table updates
Schedule: None
Next Run ID: None
01-08-2025 14:52:50
All Run Types
All Run States
Clear Filters
Auto-refresh
25
Press shift + / for Shortcuts
deferred
failed
queued
removed
restarting
running
scheduled
shutdown
skipped
success
up_for_reschedule
up_for_retry
upstream_failed
no_status
Duration
00:01:58
00:00:59
00:00:00
run_glue_merge
DAG
trigger_glue_merge_dag
Run
2025-08-01, 14:52:48 UTC
Clear
Mark state as...
Details
Graph
Gantt
Code
Event Log
Layout:
Left -> Right
run_glue_merge
success
GlueJobOperator


https://ap-south-1.console.aws.amazon.com/gluestudio/home?region=ap-south-1#/editor/job/iceberg_merge_job-Aahash/runs
Search
[Alt+S]
Asia Pacific (Mumbai)
user1 @ tsec-loud
iceberg_merge_job-Aahash
Last modified on 1/8/2025, 4:35:21 pm
Actions
Save
Run
Script
Job details
Runs
Data quality
Schedules
Version Control
Job runs (1/18) Info
Last updated (UTC)
August 1, 2025 at 14:58:40
View details
Stop job run
Troubleshoot with AI
Table View
Card View
Filter job runs by property
Run status
Retries
Start time (Local)
End time (Local)
Duration
Capacity (DPUs)
Worker type
Glue version
Succeeded 0 08/01/2025 20:22:52 08/01/2025 20:24:44 1 m 40 s 10 DPUs G.1X 5.0
Succeeded 0 08/01/2025 20:19:49 08/01/2025 20:21:18 1 m 20 s 10 DPUs G.1X 5.0
Succeeded 0 08/01/2025 17:49:34 08/01/2025 17:51:19 1 m 35 s 10 DPUs G.1X 5.0
Run details
Input arguments (10)
Logs
Run insights
Metrics
Troubleshooting analysis - preview
Spark UI
Job name
iceberg_merge_job-Aahash
Start time (Local)
08/01/2025 20:22:52
Glue version
5.0
Last modified on (Local)
08/01/2025 20:24:44
Id
jr_982eedd6fc65562dab93f52cf3b753e6479f192cefb8819118537f2ff9f0ebeb
End time (Local)
08/01/2025 20:24:44
Worker type
G.1X
Log group name
/aws-glue/jobs
Run status
Start-up time
Max capacity
Number of workers

## Phase 6 – Real-Time Streaming: Kinesis to Spark to S3 & Snowflake

Ingest live viewership logs through Kinesis → Process with Spark Streaming on EMR → Write output to **Snowflake** and **S3 (raw layer)**.

### Create EMR:




### Step 6.1 – Generate and Send Real-Time Logs to Kinesis

We used a Python script to simulate live streaming of media viewership logs to Amazon Kinesis from a pre-prepared CSV.

Script: send_to_kinesis.py

```
import boto3
import time
import csv
import io

# Initialize Kinesis client
kinesis = boto3.client('kinesis', region_name='ap-south-1')
stream_name = 'aahash-newstream'  # Replace with your actual stream name

# Open and read the CSV
with open('viewership_logs.csv', 'r') as file:
    reader = csv.reader(file)
    headers = next(reader)  # Read header row and skip

    for row in reader:
        # Convert the row back into a single CSV string
        output = io.StringIO()
        writer = csv.writer(output)
        writer.writerow(row)
        csv_data = output.getvalue().strip()
```

```
    # Send to Kinesis
    response = kinesis.put_record(
        StreamName=stream_name,
        Data=csv_data.encode('utf-8'),
        PartitionKey=row[0] if row[0] else 'default'  # Use session_id or fallback
    )

    print(f"☑ Sent CSV row: {csv_data} | Response: {response}")
    time.sleep(0.5)  # Optional: simulate streaming by throttling
```

Download CSV from S3:
aws s3 cp s3://aahash-project2/raw/viewership_logs/viewership_logs.csv
python3 send_to_kinesis.py


### Step 6.2 – Launch Spark Structured Streaming on EMR

Created a PySpark script that reads real-time data from Kinesis, transforms the JSON, and writes:

- To S3 in JSON format
- To Snowflake for analytical use

Script: spark_to_s3_snowflake.py

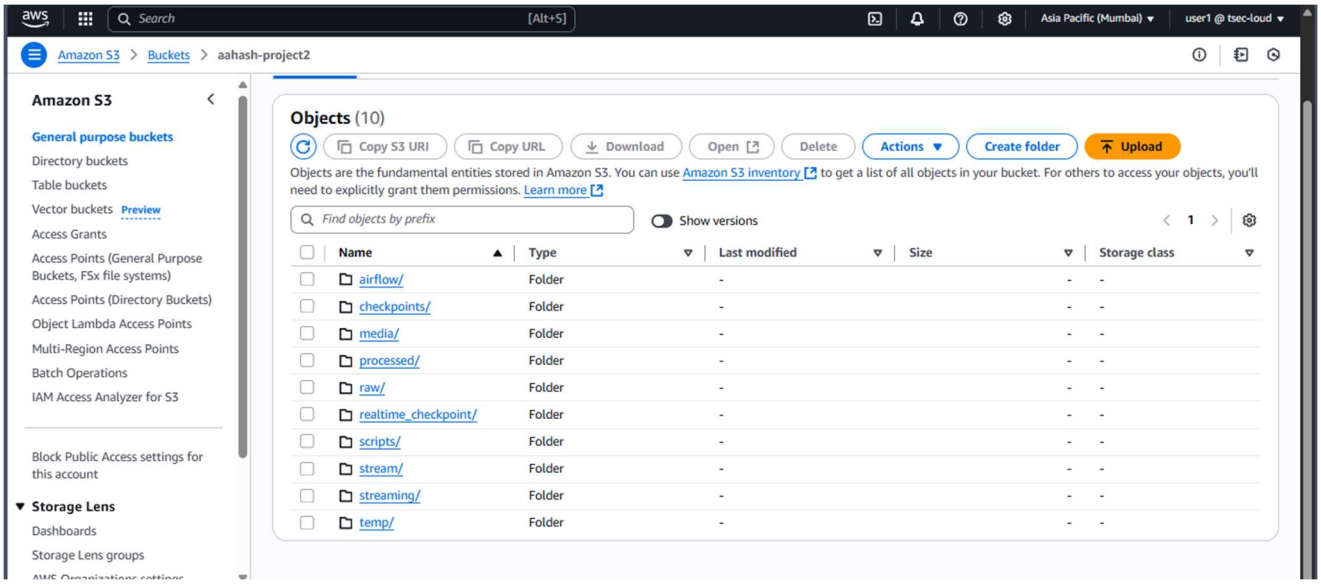
```
from pyspark.sql import SparkSession
from pyspark.sql.functions import col, expr, split
from pyspark.sql.types import *

# 1. Define the schema of the CSV-style records
schema = StructType([
    StructField("session_id", StringType()),
    StructField("user_id", StringType()),
```

```
    StructField("channel_id", StringType()),
    StructField("channel_name", StringType()),
    StructField("show_name", StringType()),
    StructField("genre", StringType()),
    StructField("timestamp", StringType()),
    StructField("duration_minutes", IntegerType()),
    StructField("region", StringType()),
    StructField("subscription_type", StringType()),
    StructField("device", StringType()),
    StructField("platform", StringType()),
    StructField("is_live", StringType()),
    StructField("ads_watched", IntegerType()),
    StructField("ad_revenue", FloatType()),
    StructField("engagement_score", FloatType()),
    StructField("buffer_count", IntegerType()),
    StructField("completion_percentage", FloatType())
])

# 2. Initialize Spark Session
print("Initializing Spark session...")
spark = SparkSession.builder \
    .appName("KinesisToS3AndSnowflake") \
    .getOrCreate()

print("Spark session initialized.")

# 3. Read from Kinesis
print("Connecting to Kinesis...")
df_raw = spark.readStream \
    .format("kinesis") \
    .option("streamName", "Aahash-newstream") \
    .option("endpointUrl", "https://kinesis.ap-south-1.amazonaws.com") \
    .option("region", "ap-south-1") \
    .option("startingPosition", "LATEST") \
    .load()
print("Connected to Kinesis.")

# 4. Convert and split raw records
df_string = df_raw.withColumn("data_string", expr("CAST(data AS STRING)"))
df_split = df_string.withColumn("fields", split(col("data_string"), ","))

# 5. Assign to structured schema
df_parsed = df_split.select(
    col("fields").getItem(0).alias("session_id"),
    col("fields").getItem(1).alias("user_id"),
    col("fields").getItem(2).alias("channel_id"),
    col("fields").getItem(3).alias("channel_name"),
    col("fields").getItem(4).alias("show_name"),
    col("fields").getItem(5).alias("genre"),
    col("fields").getItem(6).alias("timestamp"),
    col("fields").getItem(7).cast("int").alias("duration_minutes"),
    col("fields").getItem(8).alias("region"),
```

```
    col("fields").getItem(9).alias("subscription_type"),
    col("fields").getItem(10).alias("device"),
    col("fields").getItem(11).alias("platform"),
    col("fields").getItem(12).alias("is_live"),
    col("fields").getItem(13).cast("int").alias("ads_watched"),
    col("fields").getItem(14).cast("float").alias("ad_revenue"),
    col("fields").getItem(15).cast("float").alias("engagement_score"),
    col("fields").getItem(16).cast("int").alias("buffer_count"),
    col("fields").getItem(17).cast("float").alias("completion_percentage")
)

# 6. Function to write batch to S3 and Snowflake
def write_batch(batch_df, epoch_id):
    print(f"Processing batch {epoch_id}...")

    record_count = batch_df.count()
    print(f"Records in batch: {record_count}")

    if record_count == 0:
        print("Empty batch. Skipping writes.")
        return

    try:
        # Snowflake options
        snowflake_options = {
            "sfURL": "XZBTYSG-TQB56893.snowflakecomputing.com",
            "sfUser": "AAHASH06",
            "sfPassword": "Aahash@snowflake06",
            "sfDatabase": "STREAMDATA",
            "sfSchema": "PUBLIC",
            "sfWarehouse": "COMPUTE_WH",
            "sfRole": "ACCOUNTADMIN"
        }

        print("Writing to Snowflake...")
        batch_df.write \
            .format("net.snowflake.spark.snowflake") \
            .options(**snowflake_options) \
            .option("dbtable", "REALTIME_VIEWERSHIP") \
            .mode("append") \
            .save()
        print("Write to Snowflake succeeded.")

    except Exception as e:
        print("Error writing to Snowflake:", e)

    try:
        print("Writing to S3...")
        batch_df.write \
            .format("csv") \
            .mode("append") \
            .save("s3://aahash-project2/stream/")
```

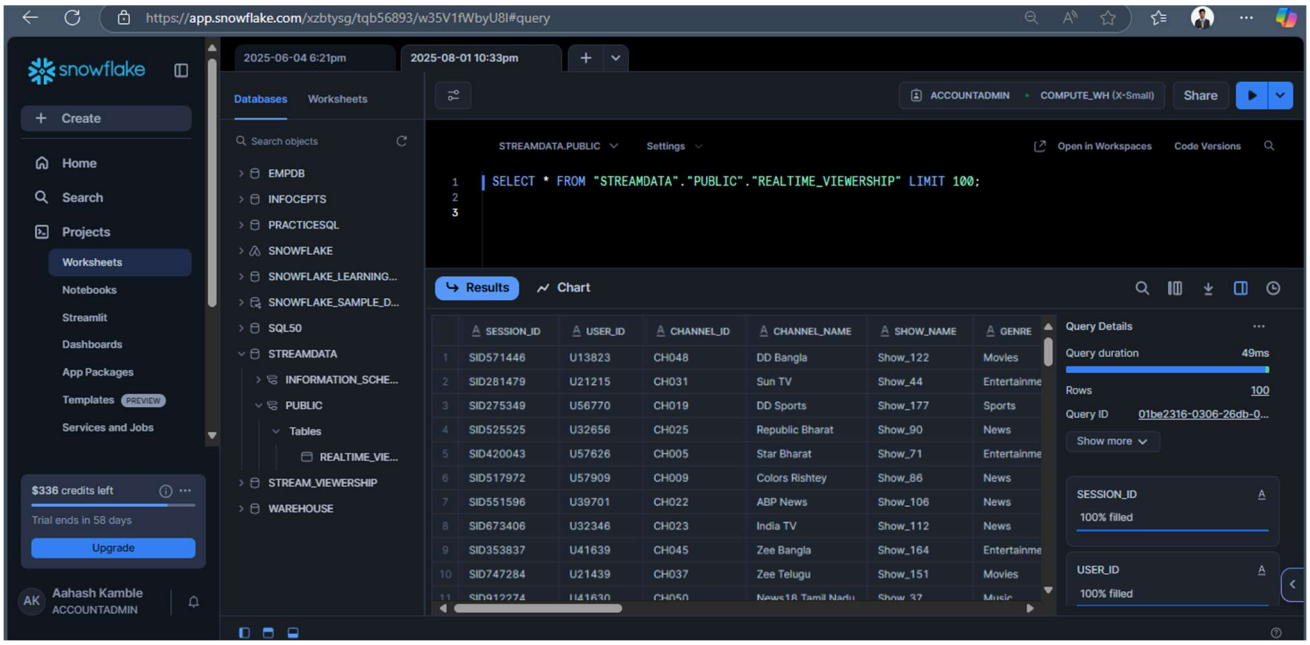
```
        print("Write to S3 succeeded.")

    except Exception as e:
        print("Error writing to S3:", e)


# 7. Start the streaming query
print("Starting streaming query...")
query = df_parsed.writeStream \
    .foreachBatch(write_batch) \
    .outputMode("append") \
    .option("checkpointLocation", "s3://aahash-project2/temp/") \
    .trigger(processingTime="10 seconds") \
    .start()

print("Streaming started.")
query.awaitTermination()
```

**After running script, you can see the file has been saved to s3**



```
25/08/01 16:46:24 INFO DAGScheduler: Job 70 finished: start at NativeMethodAccessorImpl.java:0, took 1.068577 s
25/08/01 16:46:24 WARN DefaultJDBCWrapper$: JDBC 3.13.30 is being used. But the certified JDBC version 3.13.3 is recommended.
25/08/01 16:46:24 INFO SnowflakeSQLStatement: Spark Connector Master: execute query with bind variable: desc table identifier(?)
25/08/01 16:46:25 INFO StageWriter$: Begin to write at 2025-08-01T16:46:25.458 (Coordinated Universal Time)
25/08/01 16:46:25 INFO StageWriter$: Total file count is 4, non-empty files count is 2, total file size is 1.35 KB.
25/08/01 16:46:25 INFO StageWriter$: First COPY command is: copy into viewership_stream FROM @spark_connector_load_stage_RzlDzGN7Wp/PhW7ObIfiB/
FILE_FORMAT = (
    TYPE=CSV
    FIELD_DELIMITER='|'
    NULL_IF=()
    FIELD_OPTIONALLY_ENCLOSED_BY='"'
    TIMESTAMP_FORMAT='TZHTZM YYYY-MM-DD HH24:MI:SS.FF9'
    DATE_FORMAT='TZHTZM YYYY-MM-DD HH24:MI:SS.FF9'
    BINARY_FORMAT=BASE64
  )

25/08/01 16:46:25 INFO SnowflakeSQLStatement: Spark Connector Master: execute query with bind variable: copy into viewership_stream FROM @spark_connector_load_stage_RzlDzGN7Wp/PhW7ObIfiB/
FILE_FORMAT = (
    TYPE=CSV
    FIELD_DELIMITER='|'
    NULL_IF=()
    FIELD_OPTIONALLY_ENCLOSED_BY='"'
    TIMESTAMP_FORMAT='TZHTZM YYYY-MM-DD HH24:MI:SS.FF9'
    DATE_FORMAT='TZHTZM YYYY-MM-DD HH24:MI:SS.FF9'
    BINARY_FORMAT=BASE64
  )

25/08/01 16:46:26 INFO StageWriter$: First COPY command is done in 1.32 seconds at 2025-08-01T16:46:26.780, queryID is 01be150e-0306-1f03-000a-7dcf001582ee
25/08/01 16:46:26 INFO StageWriter$: Succeed to write in 1.32 seconds at 2025-08-01T16:46:26.781
25/08/01 16:46:27 INFO StageWriter$: Spark Connector Master: Total job time is 4.57 seconds including read & upload time: 1.51 seconds and COPY time: 3.06 seconds.
25/08/01 16:46:27 WARN SnowflakeConnectorUtils$: Query pushdown is not supported because you are using Spark 3.4.1-amzn-2 with a connector designed to support Spark 3.1. Either use the version of Spark supported by the connector or install a version of the connector
 that supports your version of Spark.
25/08/01 16:46:27 WARN DefaultJDBCWrapper$: JDBC 3.13.30 is being used. But the certified JDBC version 3.13.3 is recommended.
25/08/01 16:46:27 INFO SnowflakeSQLStatement: Spark Connector Master: execute query with bind variable: select * from viewership_stream where 1 = 0
✅ Write to SnowFlake succeeded.
🪣 Writing to S3...
25/08/01 16:46:29 INFO PathOutputCommitterFactory: No output committer factory defined, defaulting to class org.apache.hadoop.mapreduce.lib.output.FileSystemOptimizedOutputCommitterFactory
25/08/01 16:46:29 INFO FileSystemOptimizedOutputCommitterFactory: EMR Optimized Committer: ENABLED
25/08/01 16:46:29 INFO FileOutputCommitter: File Output Committer Algorithm version is 2
25/08/01 16:46:29 INFO FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: true
25/08/01 16:46:29 INFO SQLConfCommitterProvider: Using output committer class org.apache.hadoop.mapreduce.lib.output.FileSystemOptimizedCommitter
25/08/01 16:46:29 INFO FileSystemOptimizedCommitter: Nothing to setup as successful task attempt outputs are written directly
25/08/01 16:46:29 INFO SparkContext: Starting job: start at NativeMethodAccessorImpl.java:0
25/08/01 16:46:29 INFO DAGScheduler: Got job 71 (start at NativeMethodAccessorImpl.java:0) with 4 output partitions
25/08/01 16:46:29 INFO DAGScheduler: Final stage: ResultStage 95 (start at NativeMethodAccessorImpl.java:0)
25/08/01 16:46:29 INFO DAGScheduler: Parents of final stage: List()
25/08/01 16:46:29 INFO DAGScheduler: Missing parents: List()
25/08/01 16:46:29 INFO DAGScheduler: Submitting ResultStage 95 (MapPartitionsRDD[407] at start at NativeMethodAccessorImpl.java:0), which has no missing parents
25/08/01 16:46:29 INFO MemoryStore: Block broadcast_95 stored as values in memory (estimated size 411.4 KiB, free 910.2 MiB)
25/08/01 16:46:29 INFO MemoryStore: Block broadcast_95_piece0 stored as bytes in memory (estimated size 151.3 KiB, free 910.0 MiB)
25/08/01 16:46:29 INFO BlockManagerInfo: Added broadcast_95_piece0 in memory on ip-172-31-19-204.ap-south-1.compute.internal:45787 (size: 151.3 KiB, free: 911.7 MiB)
25/08/01 16:46:29 INFO SparkContext: Created broadcast 95 from broadcast at DAGScheduler.scala:1592
25/08/01 16:46:29 INFO DAGScheduler: Submitting 4 missing tasks from ResultStage 95 (MapPartitionsRDD[407] at start at NativeMethodAccessorImpl.java:0) (first 15 tasks are for partitions Vector(0, 1, 2, 3))
25/08/01 16:46:29 INFO TaskSchedulerImpl: Adding task set 95.0 with 4 tasks resource profile 0
25/08/01 16:46:29 INFO TaskSetManager: Starting task 0.0 in stage 95.0 (TID 308) (ip-172-31-19-204.ap-south-1.compute.internal, executor driver, partition 0, PROCESS_LOCAL, 7459 bytes)
25/08/01 16:46:29 INFO TaskSetManager: Starting task 1.0 in stage 95.0 (TID 309) (ip-172-31-19-204.ap-south-1.compute.internal, executor driver, partition 1, PROCESS_LOCAL, 7459 bytes)
25/08/01 16:46:29 INFO TaskSetManager: Starting task 2.0 in stage 95.0 (TID 310) (ip-172-31-19-204.ap-south-1.compute.internal, executor driver, partition 2, PROCESS_LOCAL, 7459 bytes)
25/08/01 16:46:29 INFO TaskSetManager: Starting task 3.0 in stage 95.0 (TID 311) (ip-172-31-19-204.ap-south-1.compute.internal, executor driver, partition 3, PROCESS_LOCAL, 7407 bytes)
25/08/01 16:46:29 INFO Executor: Running task 0.0 in stage 95.0 (TID 308)
25/08/01 16:46:29 INFO Executor: Running task 1.0 in stage 95.0 (TID 309)
25/08/01 16:46:29 INFO Executor: Running task 3.0 in stage 95.0 (TID 311)
```

## Data received by the snowflake:



## Phase 7: Stream Analytics Using Athena

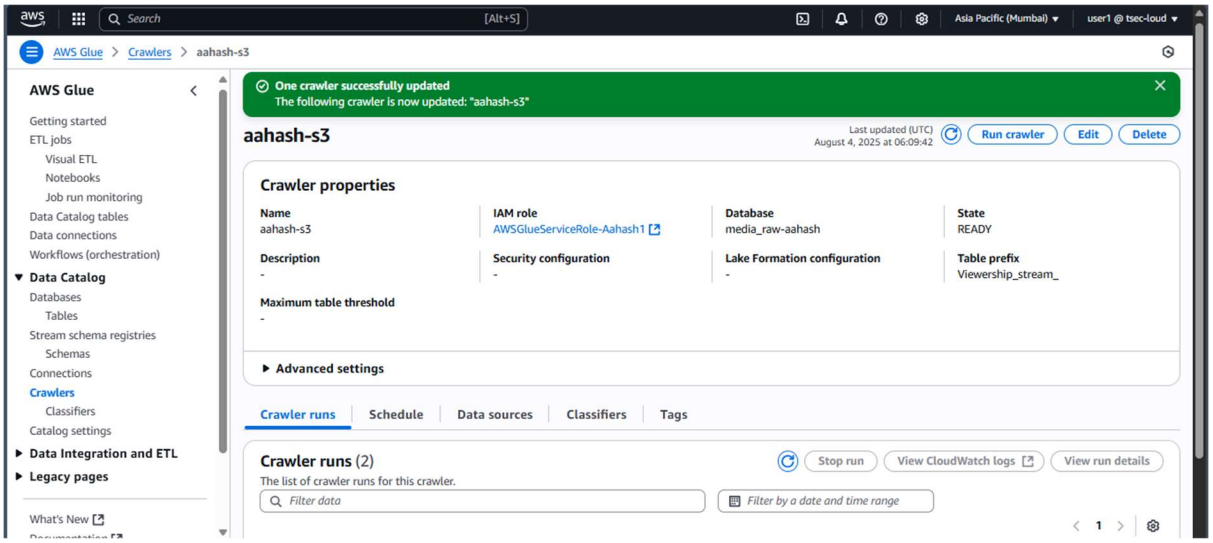
**Objective:** Analyze real-time viewership data ingested into S3 (stream1 folder) using Athena for interactive querying.

**Now we will fetch the data using crawler from s3**

Created crawler Aahash-s3

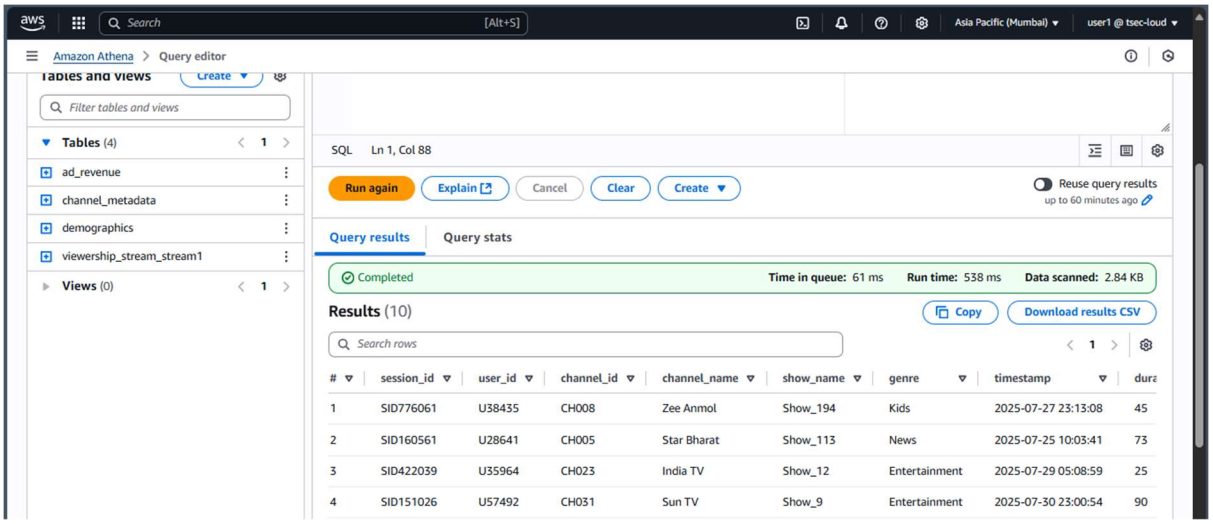
Created a **Glue Crawler**: aahashs3

- Crawls data from: s3://aahash-project2/stream1/
- Output table: viewership_stream_stream1 under database: media_raw-aahash




Verified table availability in Athena console.

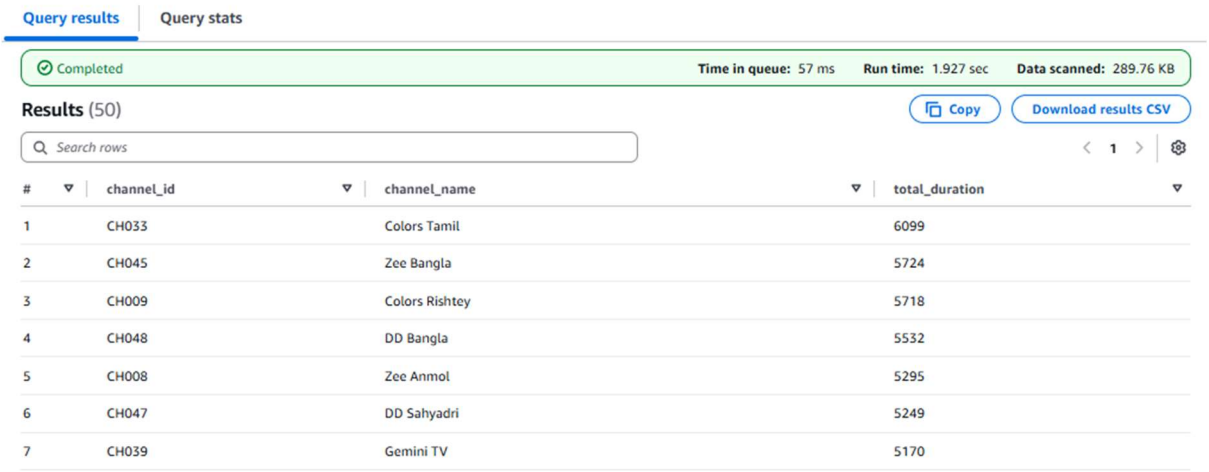
After running crawler, we can see the data:



Run the all 22 query:

1. **Total viewership duration per channel**

```
SELECT channel_id, channel_name, SUM(duration_minutes) AS total_duration
FROM viewership_stream_stream1
GROUP BY channel_id, channel_name
ORDER BY total_duration DESC;
```



Query results | Query stats

Completed — Time in queue: 57 ms — Run time: 1.927 sec — Data scanned: 289.76 KB

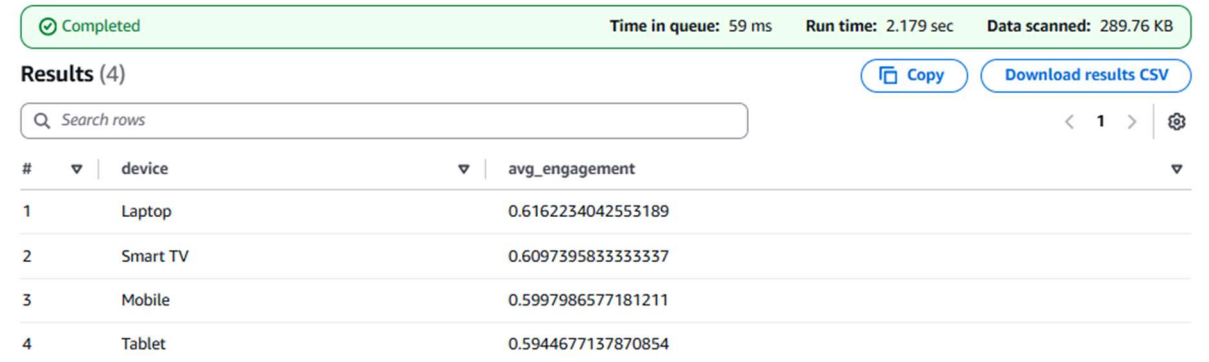
Results (50) — Copy — Download results CSV

Search rows — 1

| # | channel_id | channel_name | total_duration |
|---|---|---|---|
| 1 | CH033 | Colors Tamil | 6099 |
| 2 | CH045 | Zee Bangla | 5724 |
| 3 | CH009 | Colors Rishtey | 5718 |
| 4 | CH048 | DD Bangla | 5532 |
| 5 | CH008 | Zee Anmol | 5295 |
| 6 | CH047 | DD Sahyadri | 5249 |
| 7 | CH039 | Gemini TV | 5170 |

**2. Average engagement by device**

```
SELECT device, AVG(engagement_score) AS avg_engagement
FROM viewership_stream_stream1
GROUP BY device
ORDER BY avg_engagement DESC;
```



Completed — Time in queue: 59 ms — Run time: 2.179 sec — Data scanned: 289.76 KB

Results (4) — Copy — Download results CSV

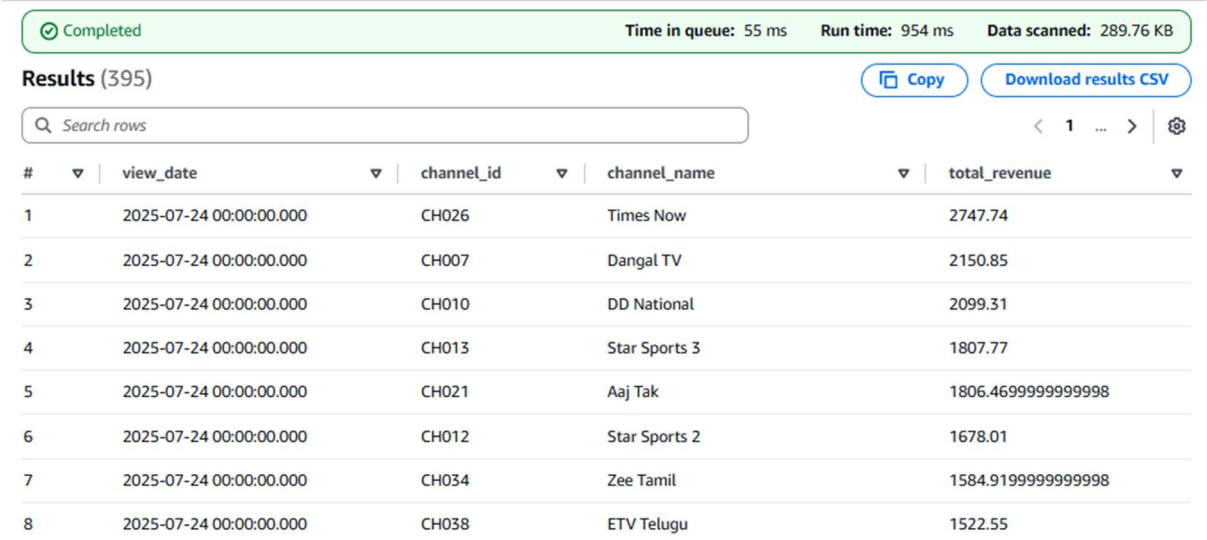
Search rows — 1

| # | device | avg_engagement |
|---|---|---|
| 1 | Laptop | 0.6162234042553189 |
| 2 | Smart TV | 0.6097395833333337 |
| 3 | Mobile | 0.5997986577181211 |
| 4 | Tablet | 0.5944677137870854 |

**3. Daily ad revenue per channel**

```
SELECT
  date_trunc('day', CAST("timestamp" AS timestamp)) AS view_date,
  channel_id,
  channel_name,
  SUM(ad_revenue) AS total_revenue
FROM viewership_stream_stream1
GROUP BY
  date_trunc('day', CAST("timestamp" AS timestamp)),
  channel_id,
  channel_name
```

```
ORDER BY
  date_trunc('day', CAST("timestamp" AS timestamp)),
  total_revenue DESC;
```



Completed | Time in queue: 55 ms | Run time: 954 ms | Data scanned: 289.76 KB

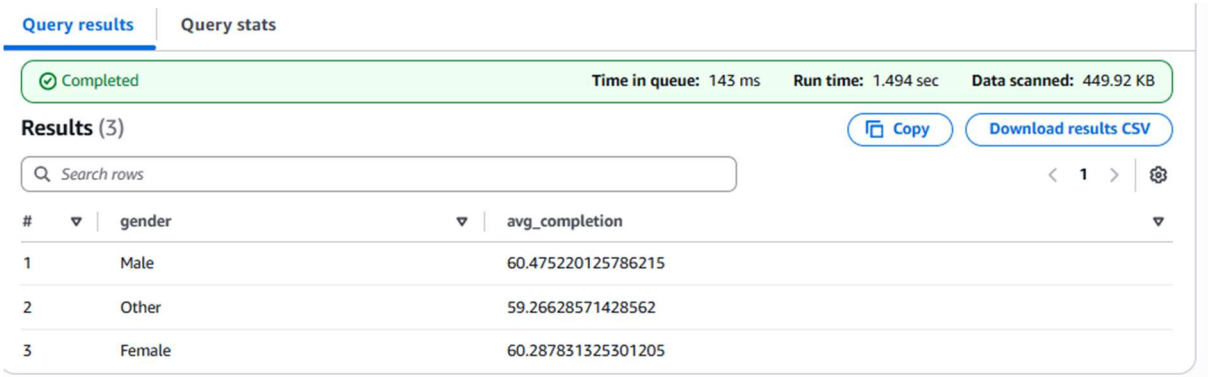
Results (395) — Copy | Download results CSV

Search rows — 1 ...

| # | view_date | channel_id | channel_name | total_revenue |
|---|---|---|---|---|
| 1 | 2025-07-24 00:00:00.000 | CH026 | Times Now | 2747.74 |
| 2 | 2025-07-24 00:00:00.000 | CH007 | Dangal TV | 2150.85 |
| 3 | 2025-07-24 00:00:00.000 | CH010 | DD National | 2099.31 |
| 4 | 2025-07-24 00:00:00.000 | CH013 | Star Sports 3 | 1807.77 |
| 5 | 2025-07-24 00:00:00.000 | CH021 | Aaj Tak | 1806.4699999999998 |
| 6 | 2025-07-24 00:00:00.000 | CH012 | Star Sports 2 | 1678.01 |
| 7 | 2025-07-24 00:00:00.000 | CH034 | Zee Tamil | 1584.9199999999998 |
| 8 | 2025-07-24 00:00:00.000 | CH038 | ETV Telugu | 1522.55 |

**4. Gender-wise average completion percentage**

```
SELECT d.gender, AVG(v.completion_percentage) AS avg_completion
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
GROUP BY d.gender;
```



Query results | Query stats

Completed | Time in queue: 143 ms | Run time: 1.494 sec | Data scanned: 449.92 KB

Results (3) — Copy | Download results CSV

Search rows — 1

| # | gender | avg_completion |
|---|---|---|
| 1 | Male | 60.475220125786215 |
| 2 | Other | 59.26628571428562 |
| 3 | Female | 60.287831325301205 |

**5. Most watched genres in each region**

```
WITH genre_ranking AS (
  SELECT
    region,
    genre,
    SUM(duration_minutes) AS total_duration,
    ROW_NUMBER() OVER (PARTITION BY region ORDER BY SUM(duration_minutes) DESC)
AS rn
  FROM viewership_stream_stream1
  GROUP BY region, genre
)
SELECT region, genre, total_duration
FROM genre_ranking
WHERE rn = 1;
```

Query results | Query stats

Completed | Time in queue: 54 ms | Run time: 1.067 sec | Data scanned: 289.76 KB

Results (7) | Copy | Download results CSV

Search rows | 1

| # | region | genre | total_duration |
|---|---|---|---|
| 1 | South | Entertainment | 9027 |
| 2 | Central | Entertainment | 8345 |
| 3 | Pan-India | Entertainment | 8786 |
| 4 | North | News | 7669 |
| 5 | West | Entertainment | 8744 |
| 6 | East | Entertainment | 7657 |

**6. Top 5 channels with highest ad revenue in the past 7 days**

```
SELECT
  channel_id,
  channel_name,
  SUM(ad_revenue) AS total_revenue
FROM viewership_stream_stream1
WHERE CAST("timestamp" AS timestamp) >= date_add('day', -7, current_date)
GROUP BY channel_id, channel_name
ORDER BY total_revenue DESC
LIMIT 5;
```

Completed | Time in queue: 60 ms | Run time: 931 ms | Data scanned: 289.76 KB

Results (5) | Copy | Download results CSV

Search rows | 1

| # | channel_id | channel_name | total_revenue |
|---|---|---|---|
| 1 | CH034 | Zee Tamil | 9623.039999999999 |
| 2 | CH023 | India TV | 8649.21 |
| 3 | CH033 | Colors Tamil | 8367.439999999997 |
| 4 | CH009 | Colors Rishtey | 8341.859999999999 |
| 5 | CH008 | Zee Anmol | 7947.169999999999 |

**7. Peak viewership hours by region**

```
WITH hourly_views AS (
  SELECT
    region,
    EXTRACT(HOUR FROM CAST("timestamp" AS timestamp)) AS view_hour,
    COUNT(*) AS views,
    ROW_NUMBER() OVER (
      PARTITION BY region
      ORDER BY COUNT(*) DESC
```

```
    ) AS rn
  FROM viewership_stream_stream1
  GROUP BY
    region,
    EXTRACT(HOUR FROM CAST("timestamp" AS timestamp))
)
SELECT
  region,
  view_hour AS hour,
  views
FROM hourly_views
WHERE rn = 1;
```

Completed | Time in queue: 56 ms | Run time: 1.134 sec | Data scanned: 289.76 KB

**Results** (7) — Copy | Download results CSV

Search rows — 1

| # | region | hour | views |
|---|---|---|---|
| 1 | South | 6 | 18 |
| 2 | Central | 9 | 24 |
| 3 | North | 2 | 21 |
| 4 | West | 2 | 27 |
| 5 | Northeast | 3 | 19 |
| 6 | East | 17 | 18 |
| 7 | Pan-India | 22 | 18 |

**8. Which age group watches the most live content?**

```
SELECT d.age_group, SUM(duration_minutes) AS total_live_duration
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
WHERE is_live = TRUE
GROUP BY d.age_group
ORDER BY total_live_duration DESC;
```

Completed | Time in queue: 56 ms | Run time: 1.37 sec | Data scanned: 449.92 KB

**Results** (6) — Copy | Download results CSV

Search rows — 1

| # | age_group | total_live_duration |
|---|---|---|
| 1 | <18 | 19494 |
| 2 | 26-35 | 18746 |
| 3 | 60+ | 18464 |
| 4 | 18-25 | 18155 |
| 5 | 46-60 | 17236 |
| 6 | 36-45 | 16875 |

**9. Subscription type driving most revenue per channel**

```
WITH revenue_by_channel_sub AS (
```

```
  SELECT
    v.channel_id,
    v.channel_name,
    d.subscription_type,
    SUM(v.ad_revenue) AS total_revenue,
    ROW_NUMBER() OVER (
      PARTITION BY v.channel_id
      ORDER BY SUM(v.ad_revenue) DESC
    ) AS rn
  FROM viewership_stream_stream1 v
  JOIN demographics d ON v.user_id = d.user_id
  GROUP BY v.channel_id, v.channel_name, d.subscription_type
)
SELECT
  channel_id,
  channel_name,
  subscription_type,
  total_revenue
FROM revenue_by_channel_sub
WHERE rn = 1;
```

**Results** (50)

Copy | Download results CSV

Search rows

1

| # | channel_id | channel_name | subscription_type | total_revenue |
|---|---|---|---|---|
| 1 | CH002 | Colors TV | Basic | 4047.670000000001 |
| 2 | CH042 | Zee Kannada | Premium | 6049.230000000001 |
| 3 | CH045 | Zee Bangla | Premium | 7251.11 |
| 4 | CH028 | NDTV India | Basic | 5192.27 |
| 5 | CH004 | Zee TV | Premium | 5895.459999999999 |
| 6 | CH049 | News18 Kerala | Premium | 4593.97 |
| 7 | CH034 | Zee Tamil | Free | 5938.500000000002 |
| 8 | CH041 | Surya TV | Premium | 6434.150000000001 |
| 9 | CH038 | ETV Telugu | Premium | 6189.53 |
| 10 | CH005 | Star Bharat | Premium | 4028.7200000000003 |

**10. High engagement sessions (more than 90% completion and >1 min)**

```
SELECT *
FROM viewership_stream_stream1
WHERE completion_percentage > 90
```

```
AND duration_minutes > 1;
```

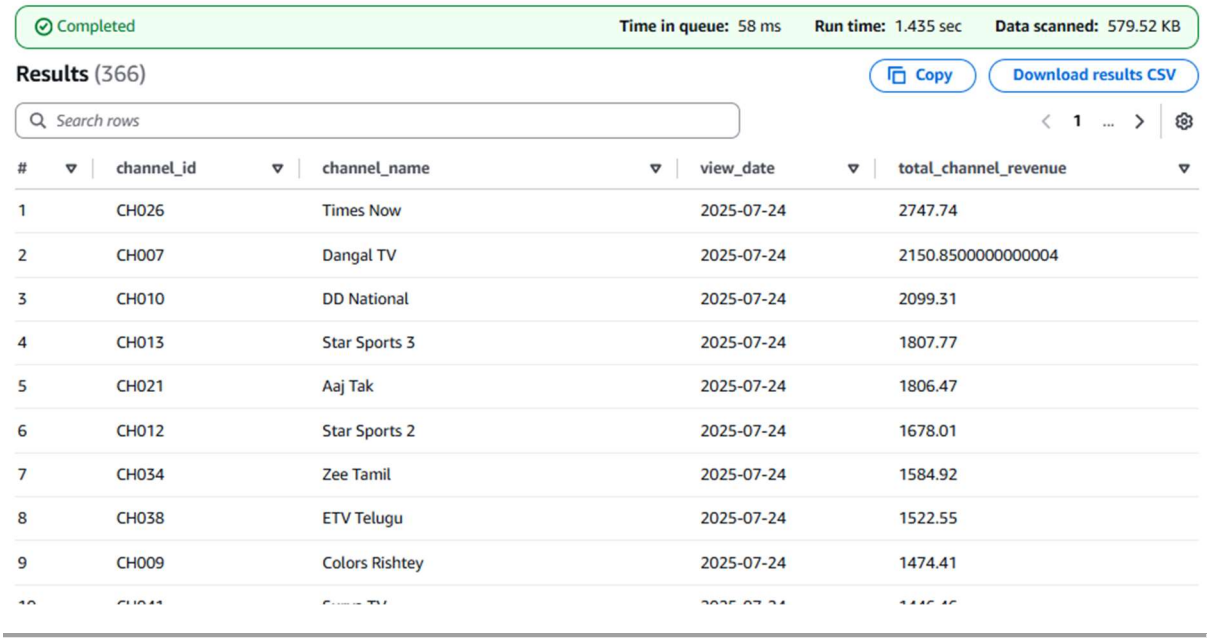
Search rows

1 ...

| # | session_id | user_id | channel_id | channel_name | show_name | genre | timestamp |
|---|---|---|---|---|---|---|---|
| 1 | SID530249 | U36362 | CH016 | Sony Sports Ten 1 | Show_157 | Sports | 2025-07-24 18:36:04 |
| 2 | SID193732 | U15187 | CH028 | NDTV India | Show_110 | News | 2025-07-29 12:49:46 |
| 3 | SID885032 | U48924 | CH007 | Dangal TV | Show_92 | Sports | 2025-07-24 14:27:10 |
| 4 | SID476466 | U29845 | CH045 | Zee Bangla | Show_182 | Entertainment | 2025-07-26 02:22:10 |
| 5 | SID686217 | U13831 | CH031 | Sun TV | Show_59 | Entertainment | 2025-07-25 02:15:24 |
| 6 | SID791008 | U13418 | CH026 | Times Now | Show_53 | News | 2025-07-24 17:46:46 |
| 7 | SID476739 | U11608 | CH029 | Zee News | Show_125 | News | 2025-07-25 18:17:07 |
| 8 | SID710536 | U11611 | CH049 | News18 Kerala | Show_115 | Music | 2025-07-26 21:53:18 |
| 9 | SID873462 | U36533 | CH027 | CNN-News18 | Show_94 | News | 2025-07-27 12:12:51 |
| 10 | SID892942 | U49841 | CH037 | Zee Telugu | Show_143 | Kids | 2025-07-25 01:45:45 |
| 11 | SID762018 | U18688 | CH039 | Gemini TV | Show_182 | Sports | 2025-07-26 12:36:09 |

**11. Channels with above-average ad revenue per day**

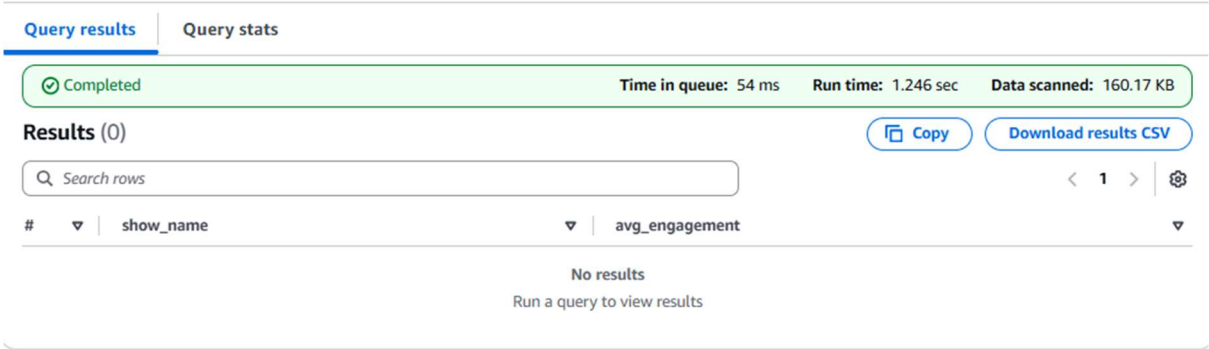
```
WITH daily_avg AS (
  SELECT
    DATE(CAST("timestamp" AS timestamp)) AS view_date,
    AVG(ad_revenue) AS avg_revenue
  FROM viewership_stream_stream1
  GROUP BY DATE(CAST("timestamp" AS timestamp))
),
channel_daily_revenue AS (
  SELECT
    DATE(CAST("timestamp" AS timestamp)) AS view_date,
    channel_id,
    channel_name,
    SUM(ad_revenue) AS total_channel_revenue
  FROM viewership_stream_stream1
  GROUP BY DATE(CAST("timestamp" AS timestamp)), channel_id, channel_name
)
SELECT
  cdr.channel_id,
  cdr.channel_name,
  cdr.view_date,
  cdr.total_channel_revenue
FROM channel_daily_revenue cdr
JOIN daily_avg da ON cdr.view_date = da.view_date
WHERE cdr.total_channel_revenue > da.avg_revenue
ORDER BY cdr.view_date, total_channel_revenue DESC;
```




| # | channel_id | channel_name | view_date | total_channel_revenue |
|---|---|---|---|---|
| 1 | CH026 | Times Now | 2025-07-24 | 2747.74 |
| 2 | CH007 | Dangal TV | 2025-07-24 | 2150.8500000000004 |
| 3 | CH010 | DD National | 2025-07-24 | 2099.31 |
| 4 | CH013 | Star Sports 3 | 2025-07-24 | 1807.77 |
| 5 | CH021 | Aaj Tak | 2025-07-24 | 1806.47 |
| 6 | CH012 | Star Sports 2 | 2025-07-24 | 1678.01 |
| 7 | CH034 | Zee Tamil | 2025-07-24 | 1584.92 |
| 8 | CH038 | ETV Telugu | 2025-07-24 | 1522.55 |
| 9 | CH009 | Colors Rishtey | 2025-07-24 | 1474.41 |

**12. Most engaging show for female users in metro regions**

```
SELECT
  show_name,
  AVG(engagement_score) AS avg_engagement
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
WHERE d.gender = 'Female'
  AND d.region IN ('Mumbai', 'Delhi', 'Bangalore', 'Hyderabad', 'Chennai')
GROUP BY show_name
ORDER BY avg_engagement DESC
LIMIT 1;
```




**13. Genre-wise ad revenue and completion comparison**

```
SELECT
  genre,
  AVG(ad_revenue) AS avg_revenue,
  AVG(completion_percentage) AS avg_completion
FROM viewership_stream_stream1
GROUP BY genre
ORDER BY avg_revenue DESC;
```

Query results | Query stats

Completed | Time in queue: 63 ms | Run time: 1.056 sec | Data scanned: 289.76 KB

Results (6)

Copy | Download results CSV

Search rows

| # | genre | avg_revenue | avg_completion |
|---|---|---|---|
| 1 | Entertainment | 276.58230529595045 | 59.569361370716486 |
| 2 | Sports | 269.7936612021859 | 59.535546448087494 |
| 3 | Movies | 258.0136666666667 | 60.45800000000003 |
| 4 | Kids | 253.59887218045114 | 59.15748120300751 |
| 5 | Music | 249.95051181102363 | 60.84488188976379 |
| 6 | News | 249.92268101761275 | 60.52017612524459 |

**14. Channels with highest buffer counts but good engagement**

```
SELECT
  channel_id,
  channel_name,
  AVG(buffer_count) AS avg_buffer,
  AVG(engagement_score) AS avg_engagement
FROM viewership_stream_stream1
GROUP BY channel_id, channel_name
HAVING
  AVG(buffer_count) > 2
  AND AVG(engagement_score) > 70
ORDER BY avg_buffer DESC;
```

Run again | Explain | Cancel | Clear | Create

Reuse query results up to 60 minutes ago

Query results | Query stats

Completed | Time in queue: 58 ms | Run time: 877 ms | Data scanned: 289.76 KB

Results (0)

Copy | Download results CSV

Search rows

| # | channel_id | channel_name | avg_buffer | avg_engagement |
|---|---|---|---|---|

No results

Run a query to view results

**15. Which age group watches the most across all the channels**

```
SELECT
  d.age_group,
  SUM(v.duration_minutes) AS total_duration
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
GROUP BY d.age_group
ORDER BY total_duration DESC;
```

Query results | Query stats

Completed | Time in queue: 81 ms | Run time: 1.136 sec | Data scanned: 449.92 KB

Results (6) | Copy | Download results CSV

Search rows | 1

| # | age_group | total_duration |
|---|---|---|
| 1 | 60+ | 38675 |
| 2 | <18 | 37686 |
| 3 | 18-25 | 37224 |
| 4 | 46-60 | 36728 |
| 5 | 26-35 | 34895 |
| 6 | 36-45 | 33328 |

**16. Average viewing time per user segmented by region**

```
WITH user_durations AS (
  SELECT
    v.user_id,
    SUM(v.duration_minutes) AS total_duration
  FROM viewership_stream_stream1 v
  GROUP BY v.user_id
)
SELECT
  d.region,
  AVG(ud.total_duration) AS avg_viewing_time
FROM user_durations ud
JOIN demographics d ON ud.user_id = d.user_id
GROUP BY d.region
ORDER BY avg_viewing_time DESC;
```

Query results | Query stats

Completed | Time in queue: 57 ms | Run time: 1.061 sec | Data scanned: 449.92 KB

Results (7) | Copy | Download results CSV

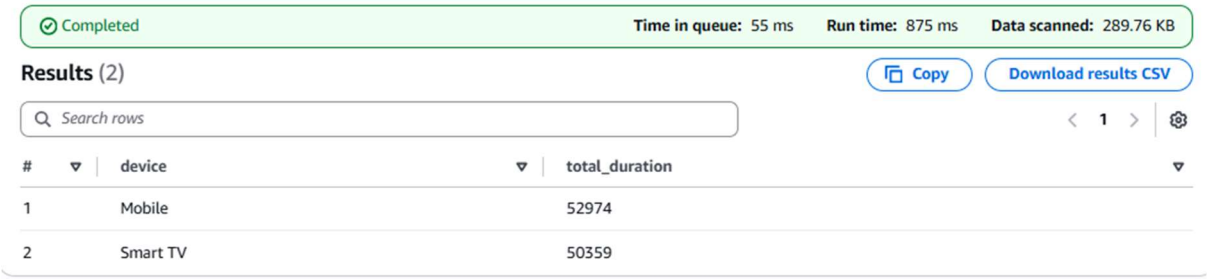
Search rows | 1

| # | region | avg_viewing_time |
|---|---|---|
| 1 | North | 120.36015325670498 |
| 2 | West | 119.29323308270676 |
| 3 | East | 118.86440677966101 |
| 4 | Pan-India | 116.16929133858268 |
| 5 | Northeast | 111.87889273356402 |
| 6 | South | 109.95578231292517 |
| 7 | Central | 108.0909090909091 |

**17. Do mobile users watch more content than Smart TV users**

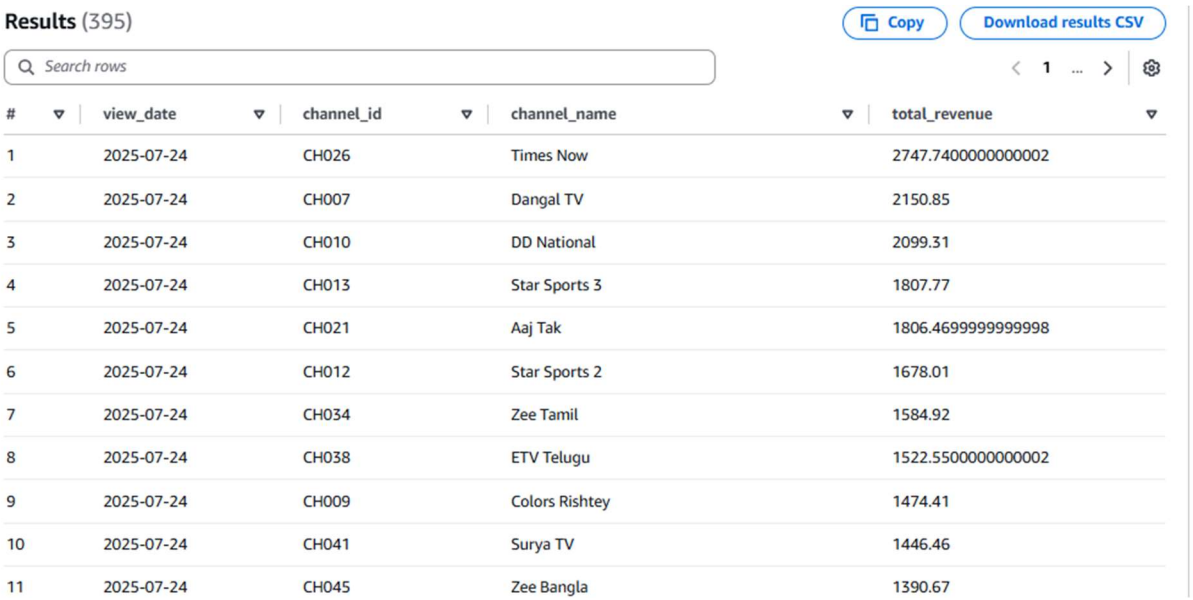
```
SELECT
  device,
```

```
  SUM(duration_minutes) AS total_duration
FROM viewership_stream_stream1
WHERE device IN ('Mobile', 'Smart TV')
GROUP BY device
ORDER BY total_duration DESC;
```




**18. Total ad revenue per channel per day**

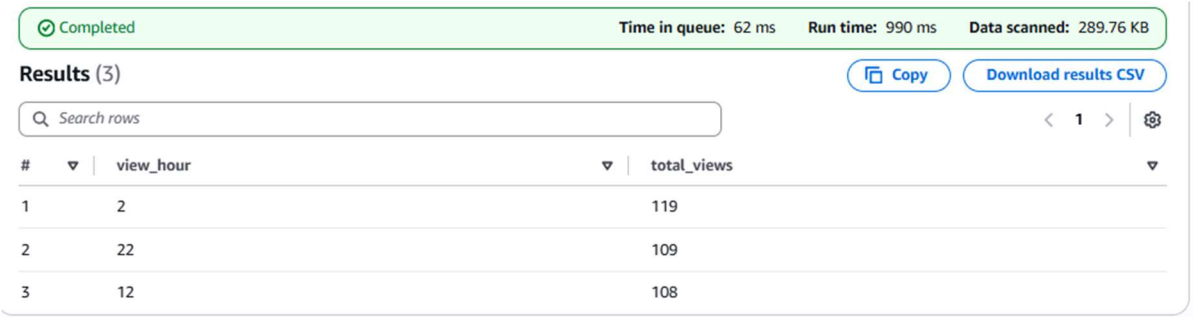
```
SELECT
  DATE(CAST("timestamp" AS timestamp)) AS view_date,
  channel_id,
  channel_name,
  SUM(ad_revenue) AS total_revenue
FROM viewership_stream_stream1
GROUP BY
  DATE(CAST("timestamp" AS timestamp)),
  channel_id,
  channel_name
ORDER BY view_date, total_revenue DESC;
```




**19. Peak hours of viewership across India**

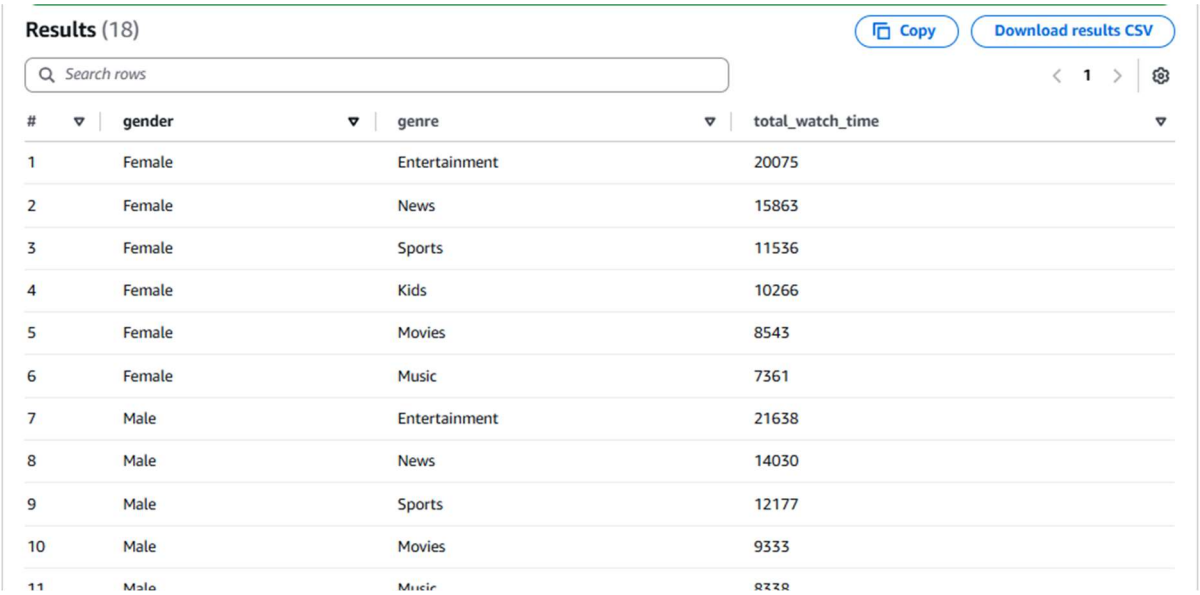
```
WITH hourly_view_counts AS (
  SELECT
    EXTRACT(HOUR FROM CAST("timestamp" AS timestamp)) AS view_hour,
```

```
  COUNT(*) AS total_views,
  ROW_NUMBER() OVER (ORDER BY COUNT(*) DESC) AS rn
 FROM viewership_stream_stream1
 GROUP BY EXTRACT(HOUR FROM CAST("timestamp" AS timestamp))
)
SELECT view_hour, total_views
FROM hourly_view_counts
WHERE rn <= 3;
```




**20. How does content genre popularity vary by gender**

```
SELECT
  d.gender,
  v.genre,
  SUM(v.duration_minutes) AS total_watch_time
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
GROUP BY d.gender, v.genre
ORDER BY d.gender, total_watch_time DESC;
```




**21. Which channels are more popular among premium subscribers**

```
SELECT
  v.channel_id,
  v.channel_name,
```

```
  SUM(v.duration_minutes) AS total_watch_time
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
WHERE d.subscription_type = 'Premium'
GROUP BY v.channel_id, v.channel_name
ORDER BY total_watch_time DESC;
```

Query results | Query stats

Completed | Time in queue: 56 ms | Run time: 1.276 sec | Data scanned: 449.92 KB

**Results** (50) — Copy | Download results CSV

Search rows — 1

| # | channel_id | channel_name | total_watch_time |
|---|---|---|---|
| 1 | CH045 | Zee Bangla | 2762 |
| 2 | CH009 | Colors Rishtey | 2598 |
| 3 | CH041 | Surya TV | 2577 |
| 4 | CH033 | Colors Tamil | 2416 |
| 5 | CH018 | Sony Sports Ten 3 | 2109 |
| 6 | CH020 | Eurosport India | 2059 |
| 7 | CH042 | Zee Kannada | 1985 |
| 8 | CH008 | Zee Anmol | 1953 |
| 9 | CH017 | Sony Sports Ten 2 | 1859 |

**22. Are certain shows driving higher engagement among female users in metro cities**

```
SELECT
  v.show_name,
  AVG(v.engagement_score) AS avg_engagement
FROM viewership_stream_stream1 v
JOIN demographics d ON v.user_id = d.user_id
WHERE d.gender = 'Female'
  AND d.region IN ('Central', 'East')
GROUP BY v.show_name
ORDER BY avg_engagement DESC
LIMIT 5;
```

**Results** (5) — Copy | Download results CSV

Search rows — 1

| # | show_name | avg_engagement |
|---|---|---|
| 1 | Show_118 | 0.99 |
| 2 | Show_8 | 0.97 |
| 3 | Show_6 | 0.97 |
| 4 | Show_23 | 0.9650000000000001 |
| 5 | Show_169 | 0.96 |