Exercise–13 Stress Testing a Linux EC2 Instance (CPU Load Test)

Objective:
To generate high CPU load on an Amazon EC2 Linux instance using the stress-ng tool and observe CPU utilization in CloudWatch.

Step 1 — Launch a Linux EC2 Instance

1. Log in to the AWS Console.
2. Go to **EC2 → Instances → Launch Instance**.
3. Name: **StressTest-EC2**
4. AMI: **Amazon Linux 2023 (Free Tier eligible)**
5. Instance type: **t2.micro** / **t3.micro**
6. Key pair: Select or create a .pem key.
7. Security Group:
    - Allow **SSH (22)** from My IP.
    - Allow **HTTP (80)** from anywhere (optional).
8. Launch the instance.

Step 2 — Connect to the EC2 Instance

Use Windows PowerShell
Navigate to the folder where pem file is located and type the following command:
ssh -i "your-key.pem" ec2-user@<public-ip>

Step 3 — Install Apache (Optional, to verify the instance is working)

sudo yum install httpd -y
sudo systemctl start httpd
sudo systemctl enable httpd
Create a test web page:
echo "<h1>EC2 Stress Test Demo — $(hostname)</h1>" | sudo tee /var/www/html/index.html

STEP 4 — Install and Run the Stress Testing Tool (stress-ng)

(For Amazon Linux 2023 EC2 Instances)
Move to the ec2-user home directory
(It is recommended to run stress-ng from the home folder)
cd ~
Install stress-ng
Amazon Linux 2023 includes stress-ng directly through dnf, so install it using:
sudo dnf install stress-ng -y
Run a CPU Stress Test
Generate high CPU load using 4 CPU workers for 2 minutes:
stress-ng --cpu 4 --timeout 120
Expected Result

- Terminal becomes busy during the 120-second load test
- After completion, you will see:

successful run completed in 120.02s

- CPU usage will spike to 90–100% (you can check using top)

Step 5 — Run Stress Test (CPU Load Generation)

Move to home directory to avoid permission issues:

```
cd ~
```

Run CPU stress for 2 minutes using 4 CPU workers:

```
stress-ng --cpu 4 --timeout 120
```

You should see messages like:

```
stress-ng: info: dispatching hogs: 4 cpu
stress-ng: info: successful run completed in 120.02s
```

This will increase CPU usage to ~100% for the duration.

Step 6 — Observe CPU Utilization in CloudWatch

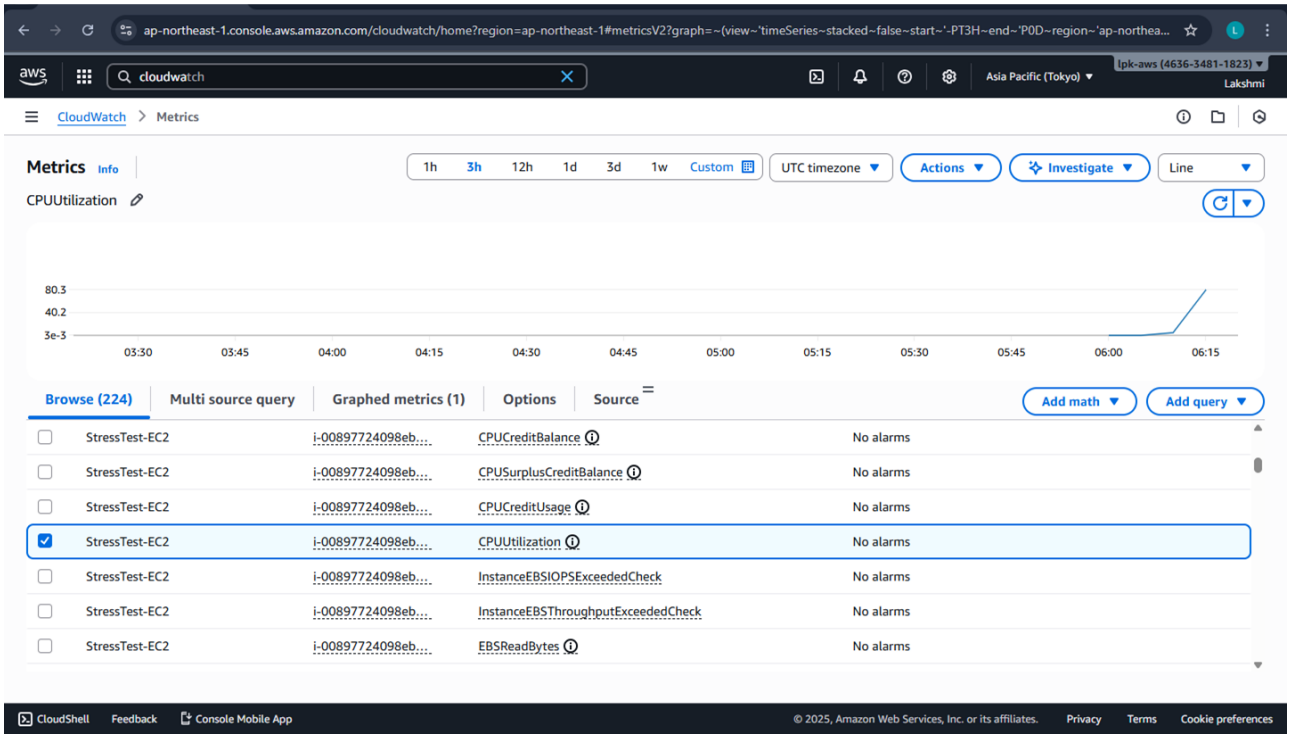
Go to CloudWatch → Metrics → EC2 → Per-Instance Metrics

Select:

CPUUtilization → InstanceId → your instance

View graph in 1-minute or 5-minute intervals.

You should see a sharp spike during the 2-minute stress period.



Step 7 — Stop or Terminate the Instance

To avoid charges:

Option A — Stop the instance (safe):

Actions → Instance State → Stop

Option B — Terminate (permanently delete):

Actions → Instance State → Terminate

Expected Output

- CPU Utilization in CloudWatch should reach 90–100%.
- Stress test completes without errors.
- Students understand how CPU load affects EC2 metrics.

Exercise–17: Flask Web App with Registration & Login Using AWS RDS (MySQL) (Full Deployment on AWS EC2 + AWS RDS)

To design and deploy a Python Flask web application on an AWS EC2 instance that allows:

1. User Registration – store Name and Password in AWS RDS MySQL database.
2. User Login – validate user credentials from the RDS database.
3. Welcome Page – display a message on successful login.

This exercise demonstrates a complete cloud-based web application workflow using Flask + MySQL (RDS).

System Architecture

Flow: Browser → Flask App (on EC2) → MySQL Database (RDS)

- Frontend: HTML templates (registration form, login form, welcome page)
- Backend: Python Flask application running on EC2
- Database: AWS RDS – MySQL engine
- Hosting: Linux EC2 instance
- Web Server: Flask's built-in development server (Apache/NGINX not used in this exercise)

Folder Structure (on EC2 instance)

Create the following structure inside the EC2 instance:

```
FlaskLoginApp/
├── app.py
├── db_config.py
└── templates/
    ├── register.html
    ├── login.html
    ├── success.html
    ├── error.html
    └── welcome.html
```

From EC2Create Database and Table in RDS MySQL

Where:
The SQL commands are executed from the EC2 instance, by connecting to the RDS MySQL database using the MySQL client.

When:
After the RDS MySQL instance status becomes "Available"
and after allowing EC2 security group access in RDS inbound rules.

Create:

- A database: flaskdb
- A table: users

SQL: Create Database and Table

```
CREATE DATABASE flaskdb;

USE flaskdb;

CREATE TABLE users (
   id INT AUTO_INCREMENT PRIMARY KEY,
   name VARCHAR(50) NOT NULL,
   password VARCHAR(50) NOT NULL
);
```

- id – unique identifier for each user (auto-increment primary key).
- name – username (cannot be NULL).
- password – password (cannot be NULL).

Note: For learning purposes, we store plain text. In real systems, passwords must be **hashed**.

Flask Application Code (Backend)

6.1 db_config.py

This file stores the **RDS MySQL connection details**.
db_config.py

```
db_config = {
   'host': 'your-rds-endpoint.amazonaws.com',
   # e.g., flaskdb-instance.xxxxxx.ap-south-1.rds.amazonaws.com
   'user': 'admin',                    # master username created in RDS
   'password': 'YourPasswordHere',          # master password created in RDS
   'database': 'flaskdb'                  # database name created in MySQL
}
```

Replace host, user, and password with the actual values from the RDS instance.

6.2 app.py

This is the **main Flask application**.

app.py

```
from flask import Flask, request, render_template
import mysql.connector
from db_config import db_config

app = Flask(__name__)

# Function to create a new database connection
def get_connection():
    return mysql.connector.connect(**db_config)

@app.route('/')
def home():
    return render_template('register.html')

@app.route('/register', methods=['POST'])
def register():
    name = request.form['uname']
    password = request.form['pwd']

    conn = get_connection()
    cur = conn.cursor()

    sql = "INSERT INTO users (name, password) VALUES (%s, %s)"
    cur.execute(sql, (name, password))
    conn.commit()

    cur.close()
    conn.close()

    # Use HTML template for success page
    return render_template('success.html')

@app.route('/login')
def login():
    return render_template('login.html')

@app.route('/validate', methods=['POST'])
def validate():
    name = request.form['uname']
    password = request.form['pwd']

    conn = get_connection()
    cur = conn.cursor()

    sql = "SELECT * FROM users WHERE name = %s AND password = %s"
    cur.execute(sql, (name, password))
    user = cur.fetchone()

    cur.close()
    conn.close()

    if user:
        # Successful login -> welcome page
        return render_template('welcome.html', username=name)
    else:
```

```
        # Invalid login -> error page
        return render_template('error.html')

if __name__ == "__main__":
    app.run(host='0.0.0.0', port=5000, debug=True)
```

7. HTML Templates (Frontend)

All HTML files go inside the templates/ folder.

7.1 templates/register.html

```
<!DOCTYPE html>
<html>
<head>
    <title>User Registration</title>
</head>
<body>
    <h2>User Registration</h2>

    <form action="/register" method="post">
        <label>Name:</label>
        <input type="text" name="uname" required><br><br>

        <label>Password:</label>
        <input type="password" name="pwd" required><br><br>

        <button type="submit">Register</button>
    </form>

    <br>
    <a href="/login">Already registered? Click here to Login</a>
</body>
</html>
```

7.2 templates/login.html

```
<!DOCTYPE html>
<html>
<head>
    <title>User Login</title>
</head>
<body>
    <h2>User Login</h2>

    <form action="/validate" method="post">
        <label>Name:</label>
        <input type="text" name="uname" required><br><br>

        <label>Password:</label>
        <input type="password" name="pwd" required><br><br>
```

```
    <button type="submit">Login</button>
  </form>

  <br>
  <a href="/">New user? Click here to Register</a>
</body>
</html>
```

7.3 templates/welcome.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Welcome</title>
</head>
<body>
  <h2>Welcome, {{ username }}!</h2>
  <p>You have successfully logged in.</p>
</body>
</html>
```

7.4 templates/success.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Registration Successful</title>
</head>
<body>
  <h3>Registration Successful!</h3>
  <a href="/login">Click here to Login</a>
</body>
</html>
```

7.5 templates/error.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Login Error</title>
</head>
<body>
  <h3>Invalid Username or Password</h3>
  <a href="/login">Try Again</a>
</body>
</html>
```

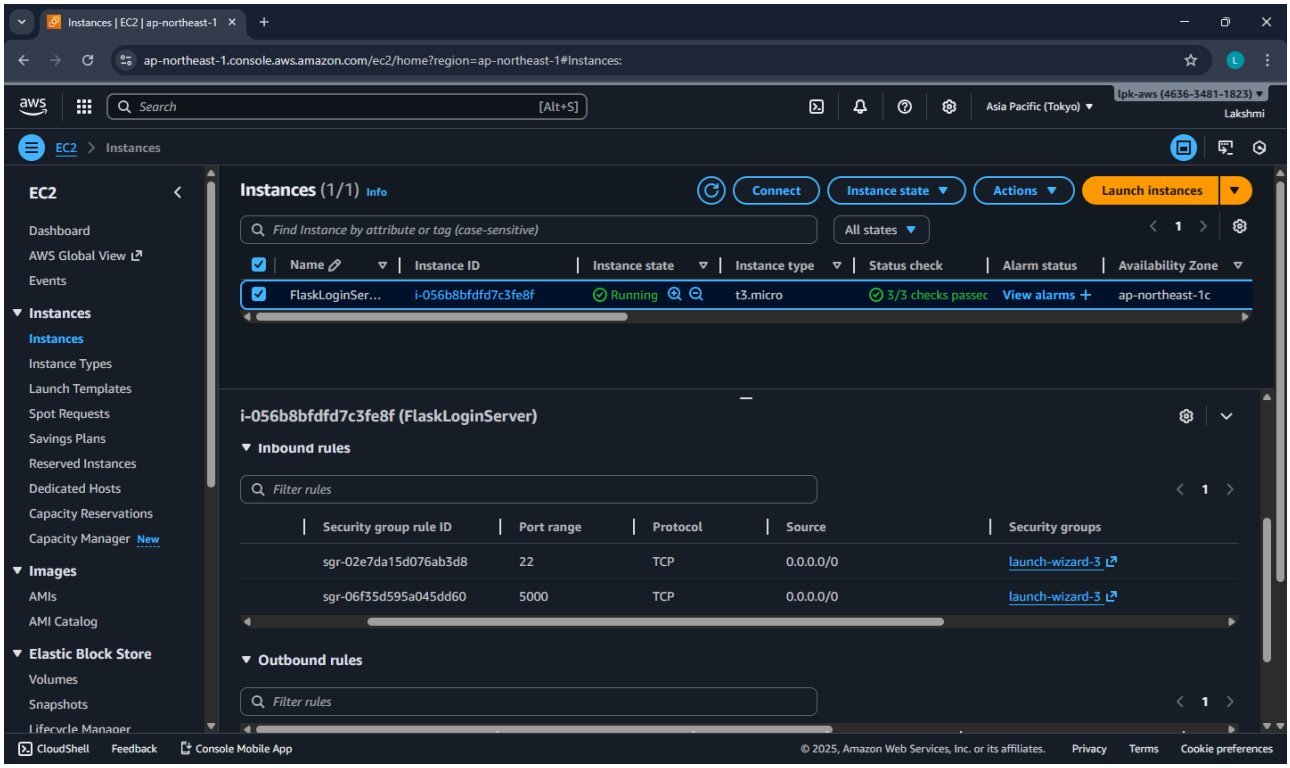
Deployment Steps –

PHASE 1 – Launch EC2 Linux Instance

- Open AWS Management Console → EC2 → Launch instance.
- Configuration:
  - Name: FlaskLoginServer
  - AMI: Amazon Linux 2023 (Free Tier eligible)
  - Instance type: t3.micro (Free Tier)
  - Key pair: create or select existing
  - Network: Default VPC and any public subnet
  - Auto-assign Public IP: Enable
- Security Group for EC2 – Inbound rules:

Type	Port	Source	Purpose
SSH	22	My IP	To connect via SSH/EC2 Connect
Custom TCP	5000	0.0.0.0/0	To test Flask app in browser

- Outbound: Allow all traffic.
- Click Launch instance.



PHASE 2 – Connect to EC2 and Install Dependencies

- Go to EC2 → Instances → Select instance → Connect.
- Choose EC2 Instance Connect (browser-based SSH) → Connect.
  Or open PowerShell on windows and connect using ssh command
- Update packages:
  sudo yum update -y
- Check Python version (Amazon Linux 2023 has Python 3):
  python3 --version

- Install pip (if not already installed):
  sudo dnf install python3-pip -y
- Install Flask and MySQL Connector for Python:
  pip3 install flask
  pip3 install mysql-connector-python

PHASE 3 – Create Flask Project Structure on EC2

- Create project folder:
  mkdir FlaskLoginApp
  cd FlaskLoginApp
- Create templates folder:
  mkdir templates
- Create the Python and HTML files using nano:
  nano db_config.py → paste code for db_config.py
  nano app.py → paste code for app.py
  nano templates/register.html → paste register page
  nano templates/login.html → paste login page
  nano templates/welcome.html → paste welcome page

Save each file using: CTRL + O → Enter → CTRL + X

PHASE 4 – Create RDS MySQL Instance

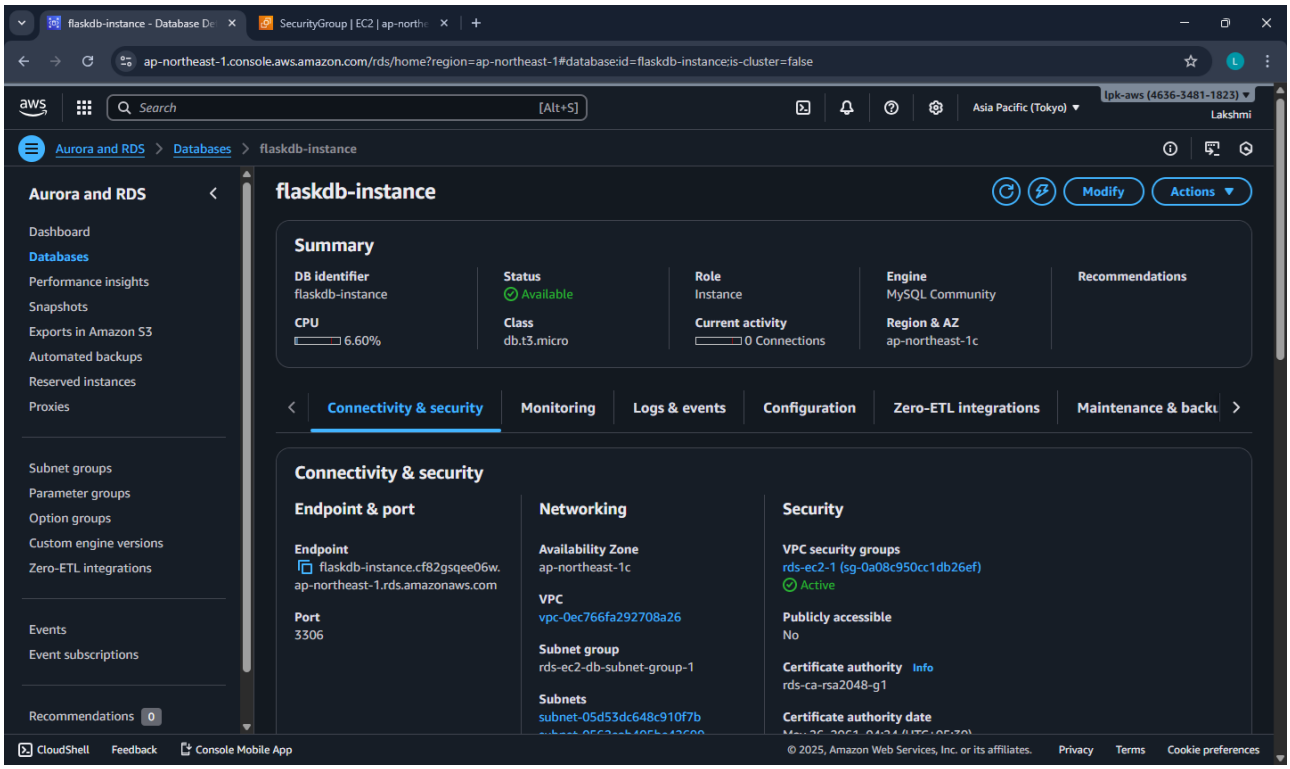
- Go to AWS Console → RDS → Databases → Create database.
  - Engine type: MySQL
  - Templates: Free tier
  - DB instance identifier: flaskdb-instance
  - Master username: admin (example)
  - Master password: <your-password>
  - DB instance class: db.t3.micro (Free tier)
  - Storage: e.g. 20 GB (Free tier)
  - Connectivity:
    - Connect to an EC2 compute resource → YES
    - Select the same EC2 instance (or its security group)
    - (AWS automatically performs the following:
      – Selects the same VPC as EC2
      – Creates/associates an RDS security group
      – Adds inbound rule: MySQL (3306) from EC2 security group)
- Public access: No
- Click Create database.
  Wait until the status becomes “Available”.

PHASE 5 – Verify RDS Security Group (Auto-configured)

- Go to AWS Console → RDS → Databases → flaskdb-instance.
- Open Connectivity & security section.
- Under VPC security groups, click the linked security group name.
- In Inbound rules, verify that the following rule exists:

Type	Port	Source
MySQL / Aurora	3306	EC2 Security Group

5. If the rule exists, EC2 to RDS connectivity is correctly configured.



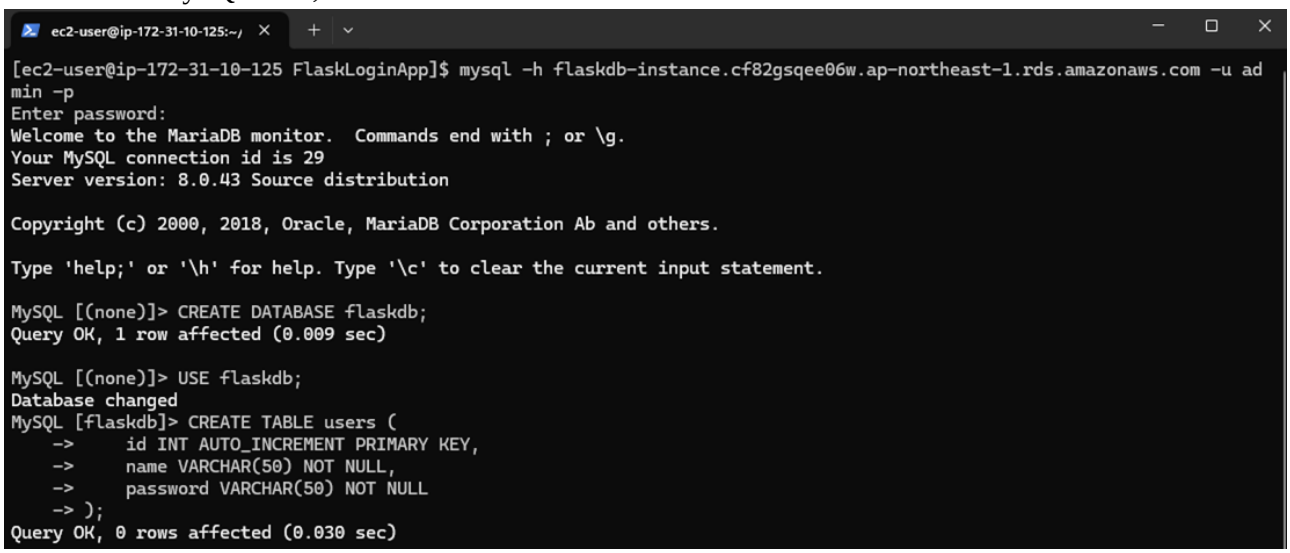
PHASE 6 – Create Database and Table in RDS from EC2

- From the EC2 terminal, install MySQL client (MariaDB client):
  sudo dnf install mariadb105 -y
  # if this fails, try: sudo dnf install mariadb -y
- Connect to the RDS MySQL instance from EC2:
  mysql -h <RDS-endpoint> -u admin -p
  Example: mysql -h flaskdb-instance.xxxxxx.ap-south-1.rds.amazonaws.com -u admin -p
- Inside the MySQL prompt, run following commands:

```
CREATE DATABASE flaskdb;

USE flaskdb;

CREATE TABLE users (
   id INT AUTO_INCREMENT PRIMARY KEY,
   name VARCHAR(50) NOT NULL,
   password VARCHAR(50) NOT NULL
```

);

- Exit MySQL: exit;

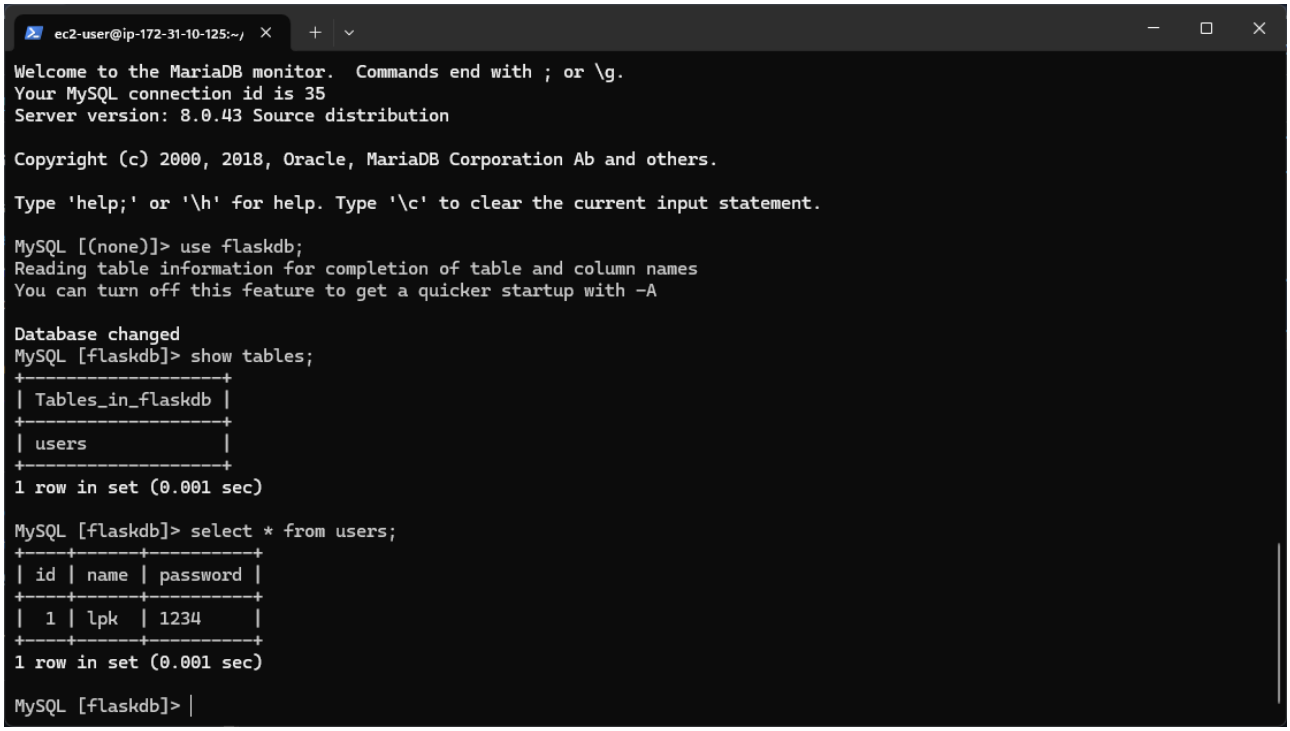


PHASE 7 – Configure Flask to Use RDS and Run Application

- Open db_config.py on EC2 and update with **correct RDS details**:
  nano db_config.py
  Ensure:
  db_config = {
  'host': 'your-rds-endpoint.amazonaws.com',
  'user': 'admin',x
  'password': 'YourPasswordHere',
  'database': 'flaskdb'
  }
  Save and exit.
- Start the Flask app:
  cd ~/FlaskLoginApp
  python3 app.py
  You should see: * Running on http://0.0.0.0:5000

PHASE 8 – Test the Application from Browser

- In your local system browser, open: http://<EC2-public-IP>:5000
  Example: http://13.232.122.81:5000
  You should see: Registration Page (default route /)
- After registration → success message with link to /login
- Login Page → if correct credentials → Welcome Page
  Check that data is stored in flaskdb.users table in RDS. - SELECT * FROM users;



Expected Output

1. Registration Page
    - User enters Name and Password.
    - On submit, data is inserted into users table in RDS MySQL.
2. Login Page
    - User enters same Name and Password.
    - Flask executes SELECT query on users table to check match.
3. Welcome Page
    - For valid credentials:

“Welcome, <username>! You have successfully logged in.”

- For invalid credentials:

“Invalid Username or Password” message with link to try again.

Result

A **fully working cloud-based registration and login system** was successfully deployed using:

- **Flask** as the backend web framework
- **HTML** templates for frontend pages
- **MySQL** database hosted on **AWS RDS**
- **AWS EC2** instance as the application server

This exercise demonstrates a **complete end-to-end mini project** on AWS using **Flask + MySQL (RDS)**.

Sample Viva Questions

1. What is **Amazon RDS**? Why do we use it instead of installing MySQL directly on EC2?
2. What is the difference between **EC2** and **RDS**?
3. How does **Flask** connect to **MySQL** in this exercise?
4. What is a **POST request**? Where is it used in this application?
5. Why must the **EC2 security group** be allowed inside **RDS inbound rules**?

   AWS RDS databases are private by default and do not allow any incoming connections unless explicitly permitted by security group rules.
   Since the Flask application runs on EC2, it must be allowed to connect to the RDS MySQL database.
   Therefore, the EC2 security group must be added to the RDS inbound rules to allow:
   - Port: 3306 (MySQL)
   - Source: EC2 Security Group

   This ensures that only the EC2 instance running the application can access the database.
6. What is the purpose of db_config.py?
7. What is **SQL Injection**? How does using parameterized queries (%s) help prevent it?

   SQL Injection:
   A technique where malicious SQL code is entered as user input.
   In this application, it is prevented using parameterized queries (%s).
8. What is the difference between **Registration workflow** and **Login workflow** in this app?
9. Why do we use host='0.0.0.0' in app.run() on EC2?

   By default, Flask runs on 127.0.0.1 (localhost), which means the application is accessible **only from inside the EC2 instance**.

   When we set: app.run(host='0.0.0.0', port=5000)

   it tells Flask to **listen on all network interfaces** of the EC2 instance.

   This allows:

- Access from the **browser on our local system**
- Access using the **EC2 public IP address**

What happens if we don't use 0.0.0.0?

- Flask listens only on localhost
- Application works **inside EC2**
- Browser access using http://<EC2-public-IP>:5000 fails

In this exercise

- Flask runs on EC2

- Users access it from outside EC2
- Therefore, Flask must listen on all interfaces using 0.0.0.0

  We use host='0.0.0.0' so that the Flask application running on EC2 is accessible from external systems using the EC2 public IP.

10. Why is debug=True not recommended in production?

DATE: 28-12-25

Exercise–18: Creating and Operating a NoSQL Key-Value Database using Amazon

DynamoDB

To create an Amazon DynamoDB table and perform CRUD operations (Create, Read, Update, Delete) using the AWS Management Console, and understand Partition Key, Sort Key, Query vs Scan, and table cleanup.

Phase 1: Create DynamoDB Table

Create a DynamoDB table to store Student Records.
Store items like: USN, Name, Semester, Course, Attendance, IA1Marks

Step 1: Open DynamoDB

- Login to AWS Console
- Search → type DynamoDB → open Amazon DynamoDB

Step 2: Create a Table

- Left menu → Tables
- Click Create table
- Fill details:

Table details

- Table name: MCA_StudentLabInternals
- Partition key (PK): USN (Type: String)
- Sort key (SK): CourseCode (Type: String)
  (Enable sort key option by setting sort key)

Why this design?

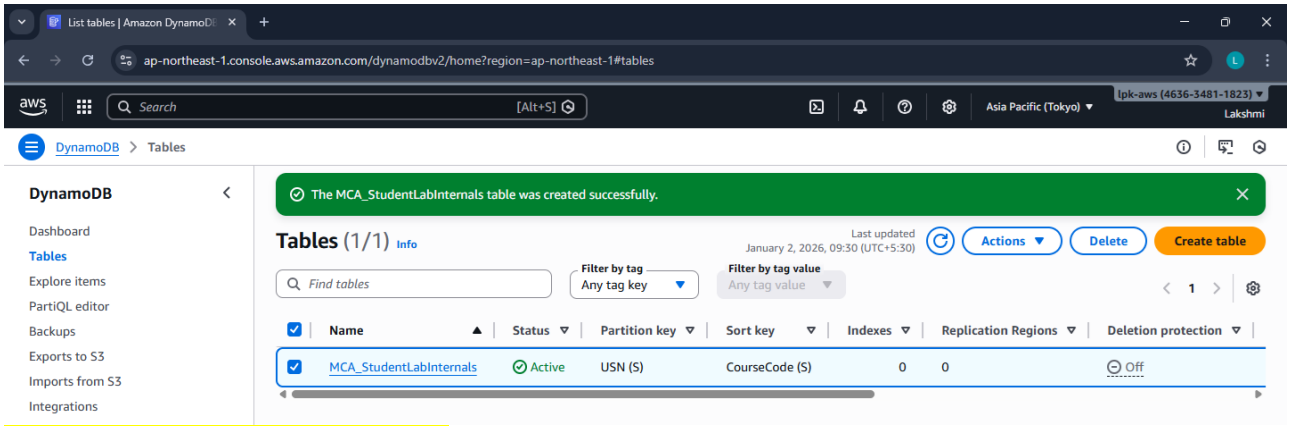
- One student can have multiple courses → Sort key separates records per course.
- This creates a composite primary key (PK + SK).

Step 3: Table settings

- Under Table settings, choose:
  Default settings (recommended for lab)
- Ensure Capacity mode is: On-demand (default already selected)

Step 4: Create

- Click Create table
- Wait until table status becomes Active



Phase 2: Insert Items (Create Data)

Step 5: Open Table and Add Items

- Click the table: MCA_StudentLabInternals
- Click: Explore table items
- Click Create item

Step 6: Add Item 1 (Student 1 - Course 1)

- You will see attributes:
  - USN (String)

- CourseCode (String)

Enter:

- USN = 1MS24MCA001
- CourseCode = CCL301

Now add additional attributes (click **Add new attribute**):

- Name (String) = Arun
- Semester (Number) = 3
- Attendance (Number) = 86
- IA1Marks (Number) = 18

Click **Create item**

Step 7: Add Item 2 (Same student - another course)

Repeat Create item with:

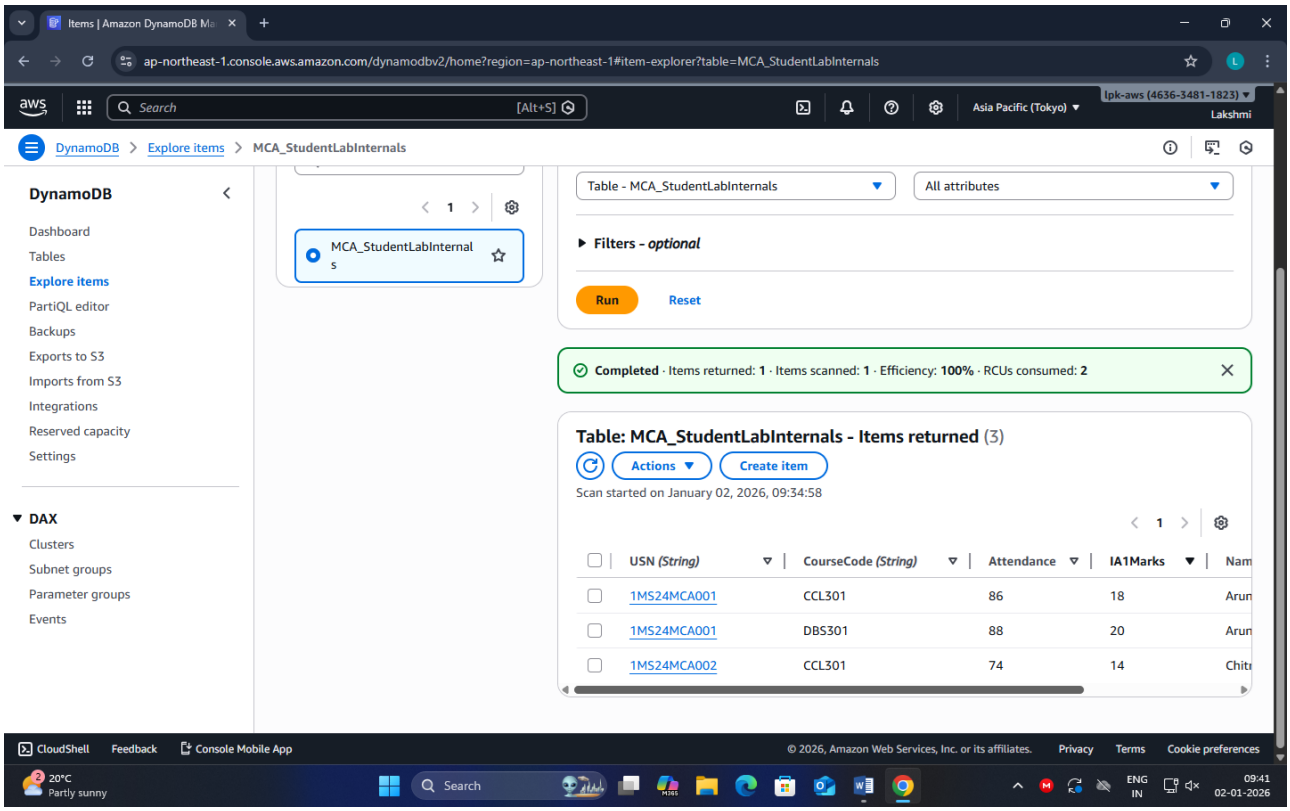
- USN = 1MS24MCA001
- CourseCode = DBS301
- Name = Arun
- Semester = 3
- Attendance = 88
- IA1Marks = 20

Step 8: Add Item 3 (Another student)

Create item:

- USN = 1MS24MCA002
- CourseCode = CCL301
- Name = Chitra
- Semester = 3
- Attendance = 74
- IA1Marks = 14

You should now see 3 items in the table list.



Phase 3: Read Data (Get / Query / Scan)

Step 9: Get a single item (exact PK + SK)

- In “Explore table items”, use search/filter:
- Use USN = 1MS24MC001 and CourseCode = CCL301
- Open the item → verify all attributes

Key concept:
To uniquely identify an item in a PK+SK table, you must provide **both**.

Step 10: Query – fetch all courses for one student

- Click Run query
- Set Partition key condition: USN equals 1MS24MCA001
- Run

Expected output:

- Items for Arun in both CCL301 and DBS301

Key concept:
Query works only with Partition Key (and optional Sort Key conditions). It is efficient.

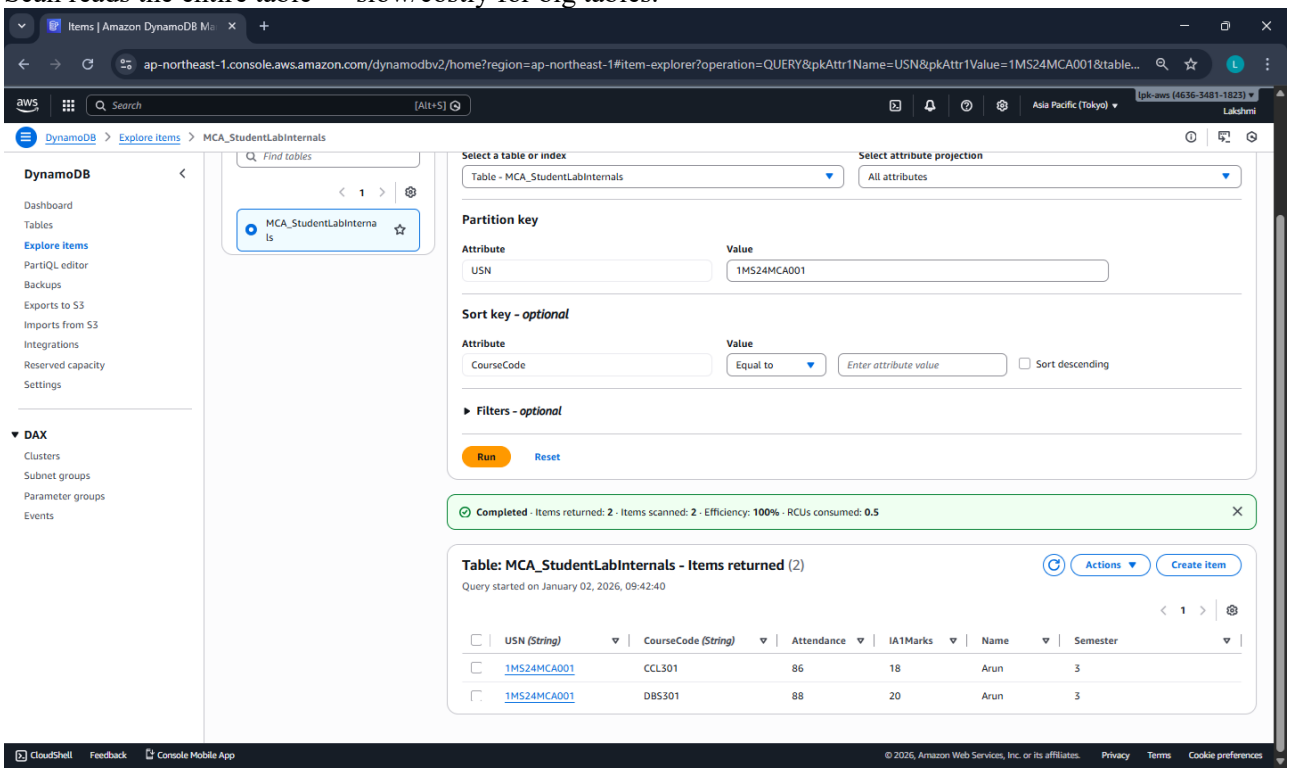
Step 11: Scan (Not for large tables)

- Click Scan
- Run scan without filters

Expected output:

- All items (Arun + Chitra)

Key concept:
Scan reads the entire table → slow/costly for big tables.



Phase 4: Update Data

Step 12: Update IA1 marks of Chitra for CCL301

- Open item where:
  USN = 1MS24MCA002
  CourseCode = CCL301

- Click Edit
- Change: IA1Marks from 14 to 16
- Click Save changes

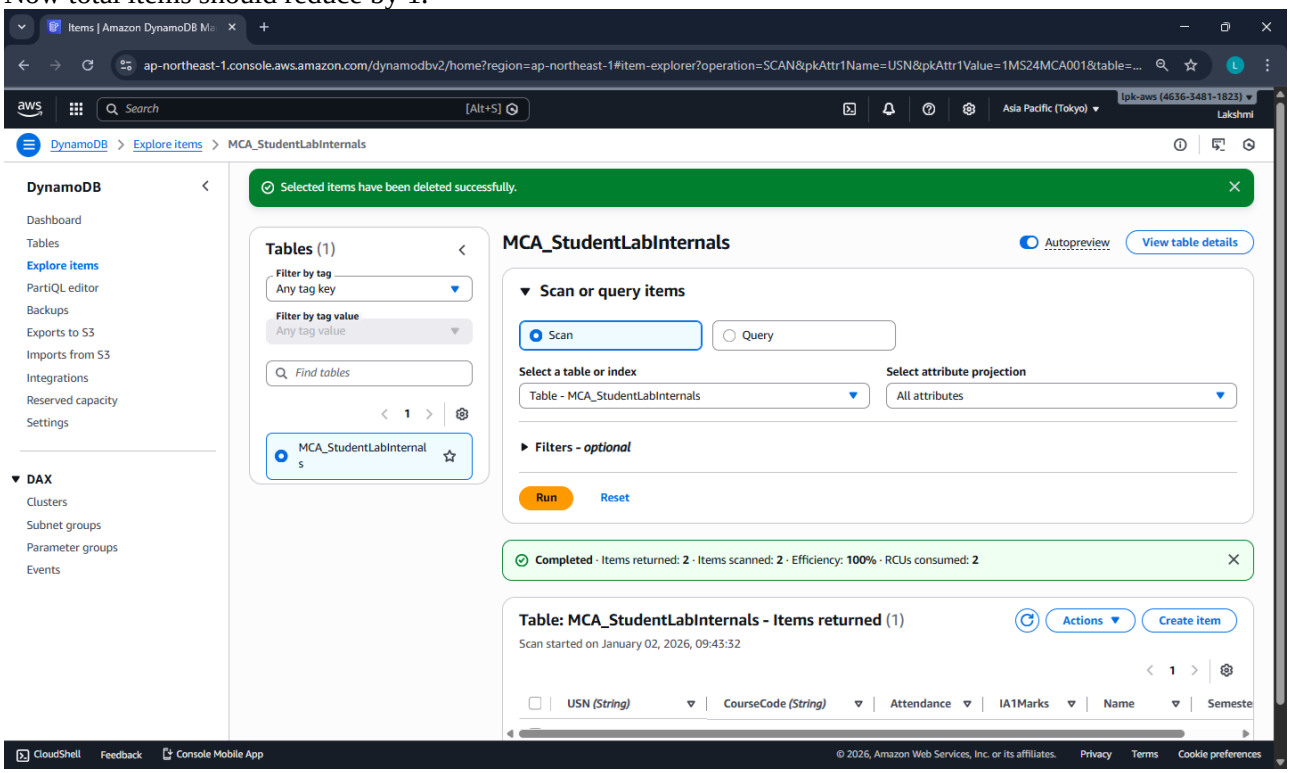
Verify updated value appears.

Phase 5: Delete Data

Step 13: Delete one item (Arun's DBS301 record)

- Select item:
  - USN = 1MS24MCA001
  - CourseCode = DBS301
- Click **Delete**
- Confirm delete

Now total items should reduce by 1.

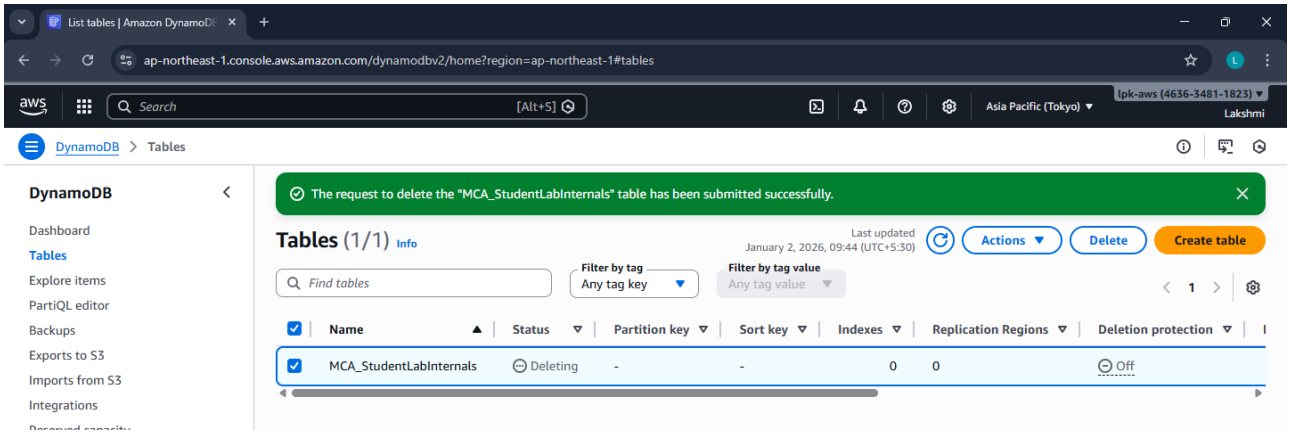


Phase 6: Cleanup (Must Do to avoid charges)

Step 15: Delete the Table

- DynamoDB → Tables
- Select MCA_StudentLabInternals
- Click Delete
- Type confirmation (if asked) and delete

Ensure table disappears from list.

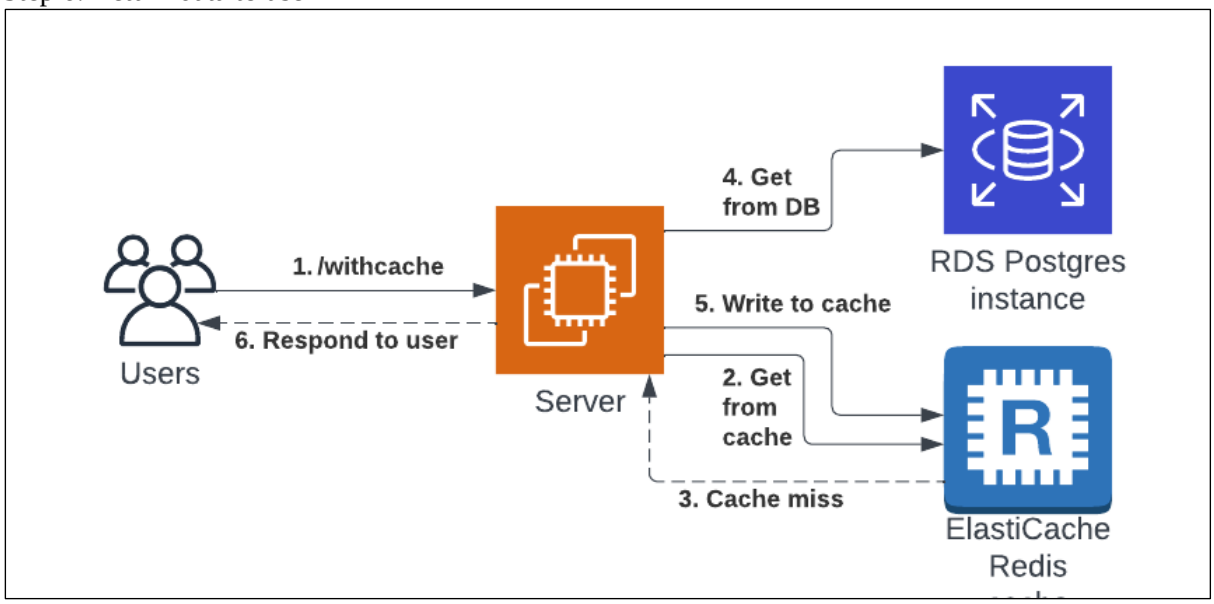

List tables | Amazon DynamoDB
ap-northeast-1.console.aws.amazon.com/dynamodbv2/home?region=ap-northeast-1#tables
Search
[Alt+S]
Asia Pacific (Tokyo)
lpk-aws (4636-3481-1823)
Lakshmi
DynamoDB > Tables
DynamoDB
Dashboard
Tables
Explore items
PartiQL editor
Backups
Exports to S3
Imports from S3
Integrations
The request to delete the "MCA_StudentLabInternals" table has been submitted successfully.
Tables (1/1) Info
Last updated
January 2, 2026, 09:44 (UTC+5:30)
Actions
Delete
Create table
Find tables
Filter by tag
Any tag key
Filter by tag value
Any tag value
1
Name
Status
Partition key
Sort key
Indexes
Replication Regions
Deletion protection
MCA_StudentLabInternals
Deleting
-
-
0
0
Off

DATE: 03-12-25

Exercise–19: ElastiCache (Redis) as an In-Memory Cache

To implement Amazon ElastiCache (Redis) as an in-memory caching service by deploying a Redis cluster and performing basic cache operations from an EC2 instance.

Application-Level Data Flow (Logical)
Step 1: User requests data
Step 2: Application checks ElastiCache (Redis)
Step 3: If data exists → return from cache (FAST)
Step 4: If data does not exist → fetch from RDS
Step 5: Store fetched data in ElastiCache
Step 6: Return data to user



This exercise provides **exposure** to an industry-used in-memory data store.
Redis improves performance by serving frequently accessed data from memory and is typically used **in front of databases** in real-world applications.

Feature	RDS	ElastiCache
Storage	Disk	RAM
Data lifetime	Permanent	Temporary
Access speed	Slower	Very fast
TTL support	No	Yes

Phase-1 → EC2 creation + valkey-cli installation
Phase-2 → Redis cache creation
Phase-3 → Connect EC2 → Redis engine and run commands

Phase-1: Launch EC2 Client using Amazon Linux 2023 (for Valkey / Redis Client)
Purpose of Phase-1
To create an EC2 instance using **Amazon Linux 2023** that will act as a **client machine** to connect to Amazon ElastiCache (Redis OSS) using **valkey-cli**.

Step 1: Select AWS Region

- Choose ONE region and stick to it for the entire exercise
  ap-south-1 (Mumbai) *(recommended)*
- Ensure ElastiCache and EC2 will be in the SAME region

Step 2: Launch EC2 Instance

1. Go to **AWS Console → EC2**
2. Click **Launch instance**

Step 3: Configure Instance Basics

- Name: RedisClient-AL2023
- AMI: Select Amazon Linux 2023 AMI
- Instance Type: Select t3.micro (Free Tier eligible)
- Key Pair: Select an existing key pair OR create a new one (RSA, .pem)
- Network & Security
  - Network
    - VPC: Default VPC
    - Subnet: No preference
    - Auto-assign public IP: Enabled
- Security Group (VERY IMPORTANT)
  Create a new security group:
  - Security Group Name: SG-RedisClient
  - Description: Security group for Redis client EC2
    Inbound Rules

Type	Port	Source
SSH	22	Anywhere 0.0.0.0/0

Do NOT add Redis (6379) here (The client does not listen on 6379)
Outbound rules: Allow all (default)

Step 5: Storage

- Keep default

Step 6: Launch Instance

- Click Launch instance
- Wait until Instance State = Running

Step 7: Connect to EC2

1. EC2 → Instances → select RedisClient-AL2023
2. Click Connect
3. Choose EC2 Instance Connect
4. Click Connect

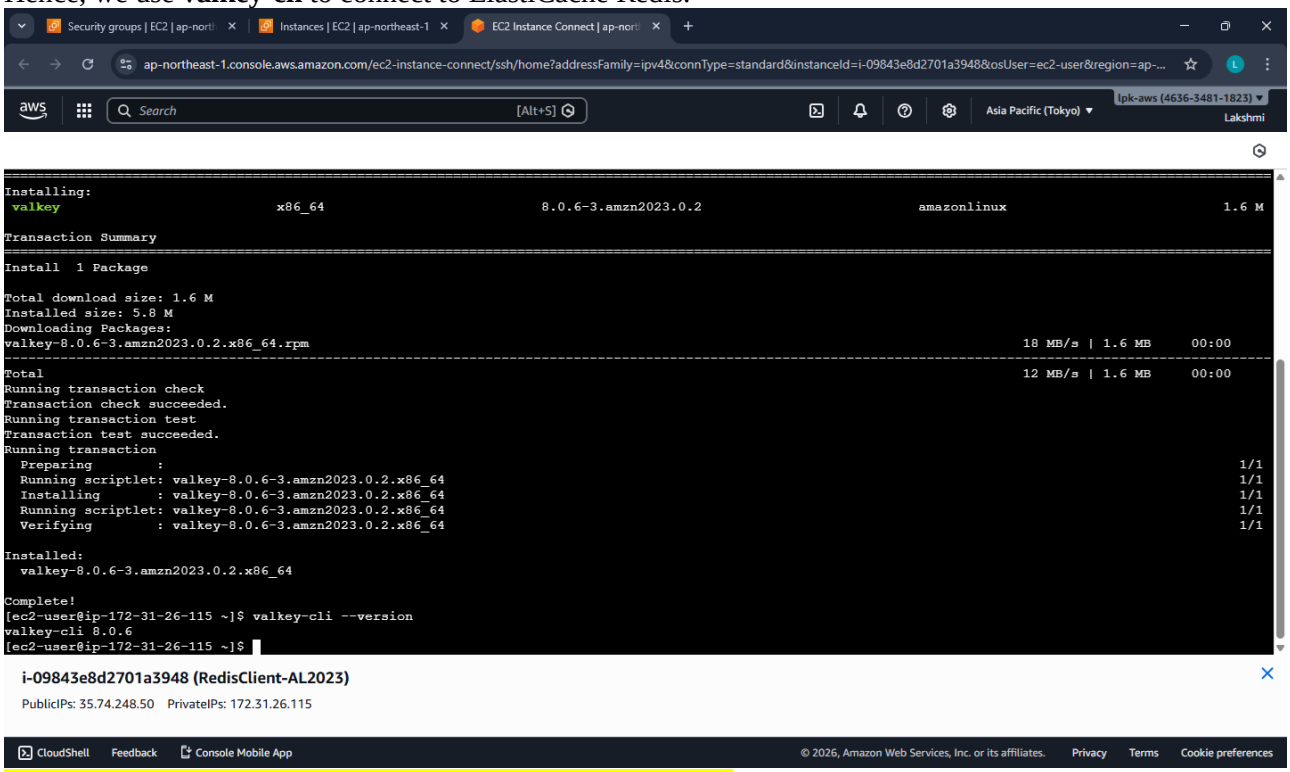
You are now inside the EC2 terminal.

Step 8: Install Valkey Client

Run the following commands:
sudo dnf update -y
sudo dnf install -y valkey

Verify installation:
valkey-cli --version
Expected Output (example)
valkey-cli 8.x.x
This confirms the EC2 is ready as a Redis-compatible client.

Note: why install valkey and not redis??
Amazon Linux 2023 does not provide redis-cli directly.
AWS now provides **Valkey**, which is fully Redis-protocol compatible.
Hence, we use **valkey-cli** to connect to ElastiCache Redis.



Phase-2: Create Amazon ElastiCache (Redis OSS) Cluster

Purpose of Phase-2
To create an Amazon ElastiCache Redis OSS cluster that will act as an in-memory cache, accessible from the EC2 client created in Phase-1.

Step 1: Confirm AWS Region
- Ensure you are in the **same region** used in Phase-1
  EC2 and ElastiCache must be in the SAME region and VPC.

Step 2: Open ElastiCache Console
1. AWS Console → **Services**
2. Select ElastiCache
3. Click Create cache

Step 3: Select Cache Engine
- **Engine**: **Redis OSS**

Step 4: Choose Deployment Settings
- Deployment option: Node-based cluster
- Creation method: Easy create

Easy create is used to avoid advanced production settings.

Step 5: Select Configuration

- **Configuration**: **Demo**

This automatically selects:

- A small, low-cost node (e.g., cache.t4g.micro)
- Suitable for labs and practice

Step 6: Provide Cluster Information

- Cache name: lab-redis
- Description: Optional (lab-redis)

Step 7: Configure Network and Subnet Group

Network

- Network type: IPv4

Subnet Group

- Select: Create a new subnet group
    - Subnet group name: redis-subnet-group
    - VPC: Default VPC
    - Subnets: Leave AWS auto-selected subnets unchanged

No manual subnet selection required.

Step 8: Configure Security

Security Group

- Create or select a security group:
    - Name: SG-RedisCache

Inbound Rule for Redis

Add **one inbound rule** to SG-RedisCache:

Type	Port	Source
Custom TCP	6379	SG-RedisClient

This allows only the EC2 client to access Redis.

Step 9: Authentication

- Authentication: Disabled

Step 10: Create Cache

1. Review all settings
2. Click Create
3. Wait until Status = Available

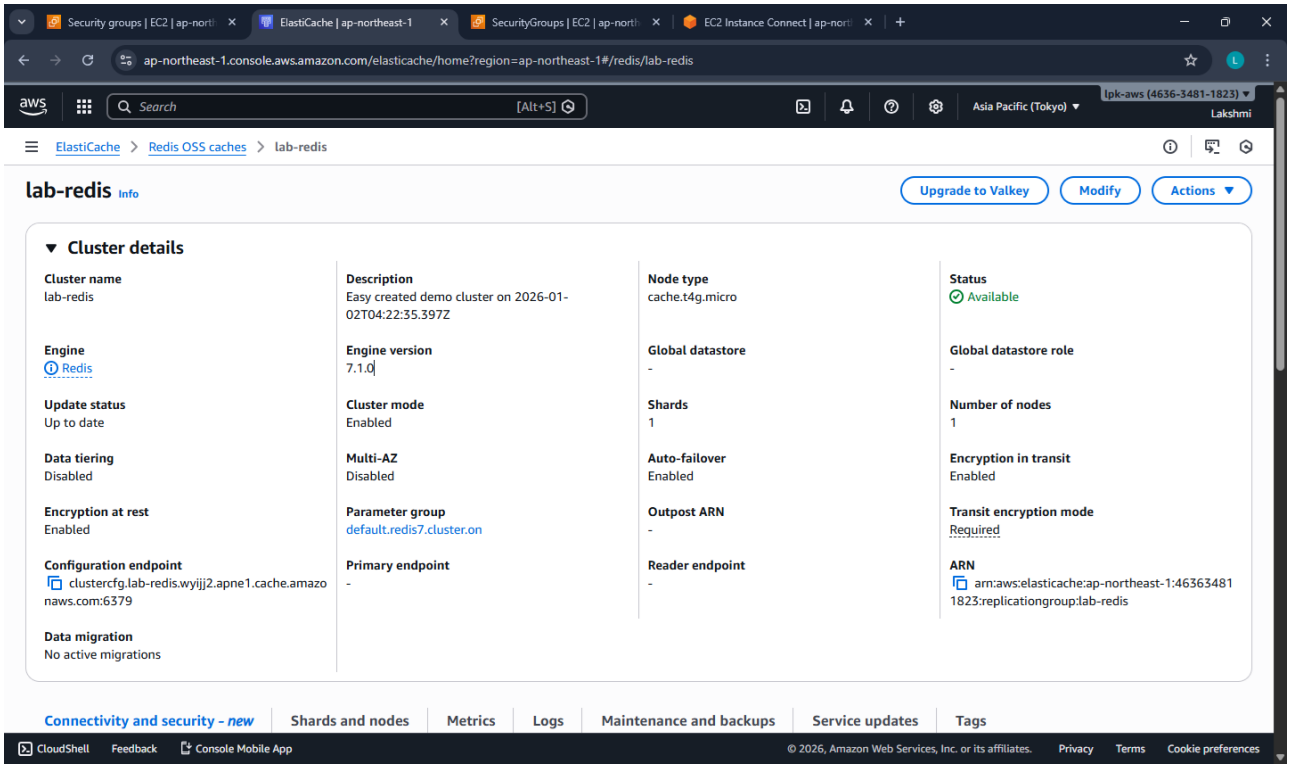
This may take a few minutes.

Step 11: Note the Redis Endpoint

1. Click on the cache name lab-redis
2. Copy the **Configuration Endpoint**
    - Example: lab-redis.xxxxxx.cache.amazonaws.com

This endpoint will be used in **Phase-3** to connect from EC2.

Note:
We have created an in-memory Redis cache using Amazon ElastiCache.
It runs inside the AWS VPC and does not have a public IP.
Only our EC2 client is allowed to access it using port 6379.



Phase-3: Connect EC2 to ElastiCache Redis and Execute Cache Commands

Purpose of Phase-3

To connect the EC2 client (Amazon Linux 2023) to the ElastiCache Redis OSS cluster using valkey-cli and demonstrate basic in-memory cache operations.

Pre-checks - Before connecting, confirm:

- EC2 and ElastiCache are in the same AWS region
- EC2 security group = SG-RedisClient
- Redis security group = SG-RedisCache
- Redis security group allows port 6379 from SG-RedisClient
- Redis Status = Available
- You have copied the Primary Endpoint

Step 1: Connect to EC2

1. AWS Console → **EC2**
2. Select instance RedisClient-AL2023
3. Click **Connect**
4. Choose **EC2 Instance Connect**
5. Click **Connect**

You are now inside the EC2 terminal.

Step 2: Verify Valkey Client

Run: valkey-cli --version

Expected Output (example)

valkey-cli 8.x.x

This confirms the EC2 is ready to act as a Redis-compatible client.

Step 3: Connect to ElastiCache Redis

Use the Configuration Endpoint from Phase-2.

valkey-cli -h < Configuration_ENDPOINT> -p 6379

Example: valkey-cli -h lab-redis.xxxxxx.cache.amazonaws.com -p 6379 --tls -c

Expected Result
You should see a prompt like:
lab-redis.xxxxxx.cache.amazonaws.com:6379>
This means the connection is successful.
Step 4: Execute Redis / Valkey Commands
These commands simulate what an application does internally.

Test Connectivity
PING
Expected Output
PONG

Store and Retrieve Data (SET / GET)
SET course "Cloud Computing"
GET course
Expected Output
"Cloud Computing"
Demonstrates **key–value storage in memory**.

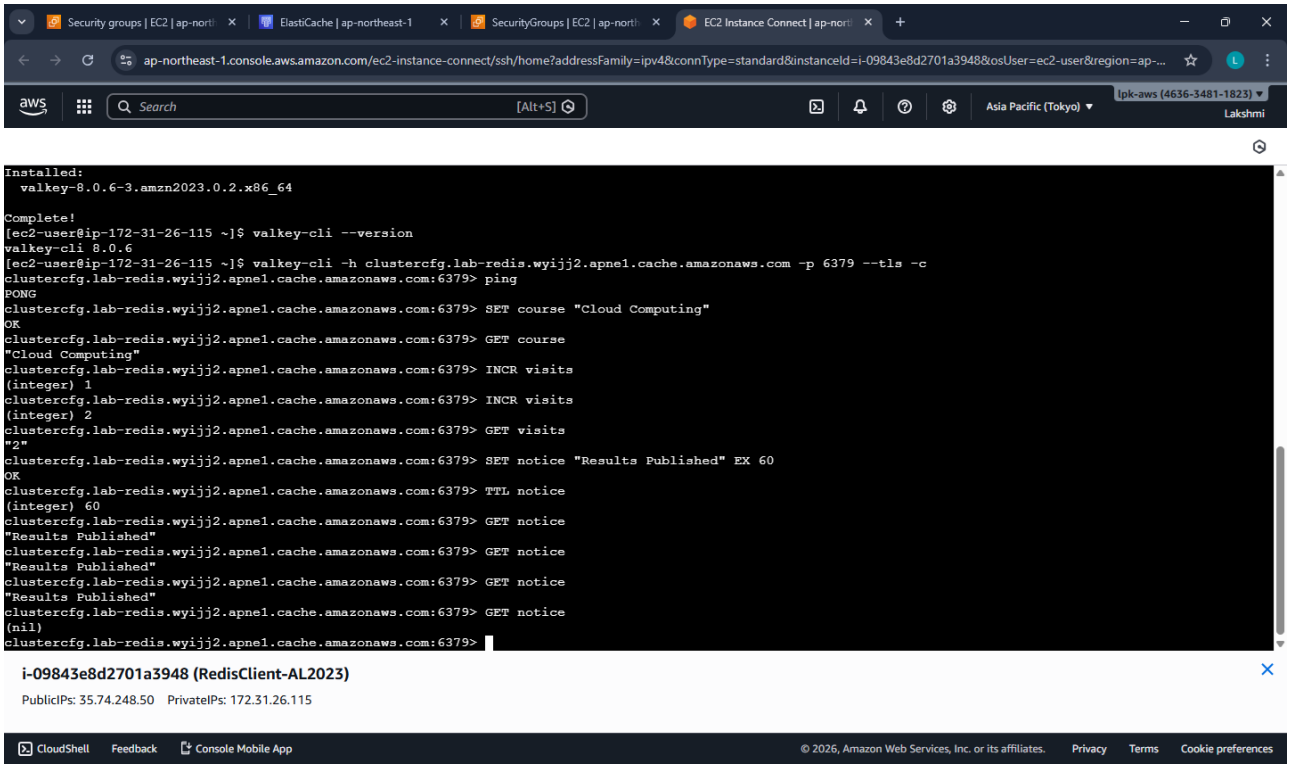
Counter Example (INCR)
INCR visits
INCR visits
GET visits
Expected Output
"2"
NOTE: Common real-world use - page views, hit counters.

4.4 Set Data with Expiry (TTL)
SET notice "Results Published" EX 60
TTL notice
GET notice
Expected Output

- TTL shows a value **≤ 60**
- GET returns:

"Results Published"
Shows **temporary cache data**.
4.5 Verify Automatic Expiry
Wait ~60 seconds, then run:
GET notice
Expected Output
(nil)
Confirms data is **automatically removed from memory**.

4.6 Delete Data Manually
DEL course
GET course
Expected Output
(nil)



Step 5: Exit Redis Client
EXIT

Note:
"The application first checks Redis.
If data is present, it is returned immediately from memory.
If not present, the application fetches data from the database and stores it in Redis with a TTL.
Redis automatically removes the data after expiry."

Phase-3 Outcome

- EC2 successfully connected to ElastiCache Redis
- In-memory key–value operations verified
- Temporary storage and TTL behavior observed
- Redis used as a **cache**, not as a primary database

Common Errors & Quick Fix

Problem	Reason	Fix
Connection timeout	Wrong SG or region	Check SG-RedisCache inbound rule
Command hangs	Redis not Available	Wait & retry
(nil) output	Key expired	Expected behavior

Clean-Up (Mandatory)

Step 1: Delete Redis Cluster

- ElastiCache → Select lab-redis → Delete
- Disable snapshots

Step 2: Terminate EC2 Instance

- EC2 → Instances → Terminate RedisClient-EC2

Step 3: Optional

- Delete unused security groups

Redis Commands Explanation

- **SET** course "Cloud Computing"
- **GET** course
- **EXPIRE** course 30
- **TTL** course
- The above commands simulate application caching behavior.
  The SET command represents storing frequently accessed data in cache.
  The EXPIRE command shows that cached data is temporary and stored in memory.
  After expiry, the application would fetch fresh data from the database again.

Exercise–22: CloudFormation – Launch EC2 (Amazon Linux 2023) + Install Apache using UserData

Create an EC2 instance using AWS CloudFormation (YAML template) and automatically install Apache web server (httpd) using UserData, then verify the website from a browser.

Pre-requisites

- Region set to **Asia Pacific (Mumbai) – ap-south-1**
- Basic knowledge of EC2 and Security Groups

Part A — Create Key Pair (One-time setup)

Step A1: Open EC2 Key Pairs

1. AWS Console → Search **EC2**
2. Left menu → **Key Pairs** (under "Network & Security")
3. Click **Create key pair**

Step A2: Create key pair

- Name: pemkeypair (any name is fine)
- Key pair type: **RSA**
- Private key file format:
  - **.pem** (recommended)

Click **Create key pair**
A file will download like: pemkeypair.pem
Note: CloudFormation uses **key pair NAME** (pemkeypair), not the file name.

Part B — Create CloudFormation Template File (Amazon Linux 2023 + Apache)

Step B1: Create YAML file on your computer

1. Open **Notepad**

2. Paste the full YAML template given below
3. Save as: **ec2-apache-al2023.yaml**
    - Save type: **All files**
    - Encoding: UTF-8 (if asked)

Full CloudFormation Template (Amazon Linux 2023)

Important:

- Do **not** add .pem anywhere.
- You will select Key Pair from dropdown during stack creation.

```
AWSTemplateFormatVersion: "2010-09-09"
Description: Launch EC2 (Amazon Linux 2023) and install Apache (httpd) using UserData

Parameters:
  KeyName:
    Type: AWS::EC2::KeyPair::KeyName
    Description: Select an existing EC2 Key Pair to enable SSH access

Resources:
  WebServerSG:
    Type: AWS::EC2::SecurityGroup
    Properties:
      GroupDescription: Allow SSH (22) and HTTP (80)
      SecurityGroupIngress:
        - IpProtocol: tcp
          FromPort: 22
          ToPort: 22
          CidrIp: 0.0.0.0/0
        - IpProtocol: tcp
          FromPort: 80
          ToPort: 80
          CidrIp: 0.0.0.0/0
```

```
  WebServerInstance:
    Type: AWS::EC2::Instance
    Properties:
      InstanceType: t3.micro
      KeyName: !Ref KeyName
      SecurityGroups:
        - !Ref WebServerSG

      # Amazon Linux 2023 AMI for Mumbai (ap-south-1)
      ImageId: ami-02b49a24cfb95941c

      UserData:
        Fn::Base64: |
          #!/bin/bash
          dnf update -y
          dnf install -y httpd
          systemctl enable httpd
          systemctl start httpd
          echo "<h1>Apache Installed via CloudFormation UserData (Amazon Linux 2023)!</h1>" >
/var/www/html/index.html

Outputs:
  InstanceId:
    Description: EC2 Instance ID
    Value: !Ref WebServerInstance


  WebsiteURL:
    Description: Apache Website URL
    Value: !Sub "http://${WebServerInstance.PublicDnsName}"
```

Part C — Create CloudFormation Stack (Console Steps)

Step C1: Open CloudFormation

1. AWS Console → Search **CloudFormation**
2. Click **Stacks**
3. Click **Create stack** → **With new resources (standard)**

Step C2: Prepare template (select correct options)

1. Under **Prepare template**:
   Select **Choose an existing template**
2. Under **Template source**:
   Select **Upload a template file**
3. Click **Choose file** → select ec2-apache-al2023.yaml
4. Click **Next**

Part D — Specify Stack Details

Step D1: Stack name

- Stack name: EC2-Apache-AL2023

Click **Next**

Step D2: Parameters

- Under **KeyName**, select your key pair name from dropdown
  Example: pemkeypair

Click **Next**

Part E — Configure Stack Options (keep default)

1. Leave everything as default
2. Click **Next**

Part F — Review and Create

1. Scroll down
2. Click **Create stack**

Part G — Monitor Stack Creation

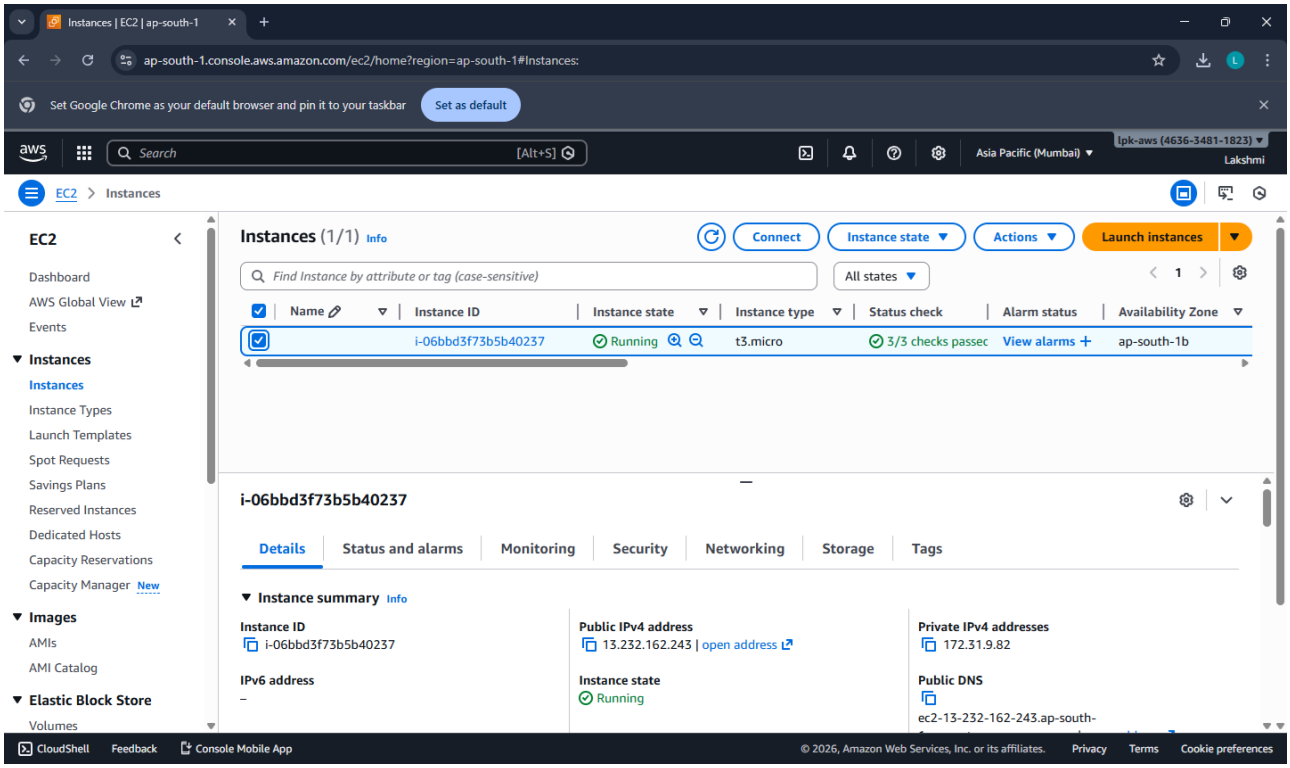
1. Wait for Stack status to become:
   CREATE_COMPLETE
2. Open the stack → click **Outputs** tab
3. Copy **WebsiteURL**
4. Paste URL in browser

Expected Output in browser:
Apache Installed via CloudFormation UserData (Amazon Linux 2023)!

Part H — Verify in EC2 (Optional)

1. Go to **EC2 → Instances**
2. Instance should be running
3. Security group should allow:

- SSH 22
- HTTP 80



Troubleshooting (Common Errors)

1) Website not opening

Check:

- EC2 instance status checks are **2/2 passed**
- Security group has **port 80 open**
- Wait 2–3 minutes (UserData takes time)

2) Stack went to ROLLBACK

Go to stack → **Events tab** → check the failure reason
Most common reason:

- Wrong Key Pair selected / key pair does not exist

Part I — Clean-up

To avoid charges:

1. CloudFormation → Stacks
2. Select EC2-Apache-AL2023
3. Click **Delete**
4. Confirm

This deletes EC2 + Security Group automatically.

DATE: 17-12-25

Exercise–23: EC2 + S3 (Static Content Pulled from S3 using CloudFormation)

Create an **S3 bucket** using CloudFormation.

Upload a static HTML file (index.html) to S3.

Launch **EC2 (Amazon Linux 2023) + Apache** using CloudFormation.

EC2 will **pull index.html from S3** and host it via Apache.

Pre-requisites

- Region: **Mumbai (ap-south-1)**
- A Key Pair exists (example: pemkeypair)

PART 0 — One-time: Create Key Pair

EC2 → Key Pairs → Create key pair

- Name: pemkeypair
- Format: .pem
  Download it and keep safe.

PART 1 — Stack-1: Create S3 Bucket (CloudFormation)

Step 1.1: Create S3 template file

Create a file: **stack1-s3-bucket.yaml** and paste:

```
AWSTemplateFormatVersion: "2010-09-09"

Description: Create an S3 bucket to store website content (index.html)


Resources:

  WebsiteBucket:

    Type: AWS::S3::Bucket


Outputs:
```

```
  BucketName:
    Description: S3 Bucket Name (use this to upload index.html)
    Value: !Ref WebsiteBucket
```

Step 1.2: Create stack

CloudFormation → Stacks → Create stack → With new resources

- Choose an existing template
- Upload a template file → stack1-s3-bucket.yaml
- Stack name: S3-Website-Bucket
- Create stack

Step 1.3: Copy bucket name

Open stack → **Outputs** → copy **BucketName**

PART 2 — Upload Static Content to S3 (Manual)

Step 2.1: Create index.html on your PC

Create a file named **index.html** with this content:

```
<!DOCTYPE html>
<html>
<head>
  <title>EC2 + S3 Demo</title>
</head>
<body>
  <h1>Hello! This page was pulled from S3 to EC2 automatically.</h1>
  <p>Deployed using CloudFormation + UserData</p>
</body>
</html>
```

Step 2.2: Upload to S3 bucket

S3 → Buckets → open your bucket (from Output) → Upload

- Upload **index.html**
- Keep it at **root** (no folder)
- Upload

Now S3 has: s3://<your-bucket-name>/index.html

PART 3 — Stack-2: Launch EC2 + Apache + Pull from S3

This stack will:

- Create IAM Role (permission to read the bucket)
- Create Security Group (22, 80)
- Launch EC2 (Amazon Linux 2023)
- Install Apache
- Copy index.html from S3 to /var/www/html/index.html

Step 3.1: Create EC2 template file

Create a file: **stack2-ec2-pull-from-s3.yaml** and paste:

```
AWSTemplateFormatVersion: "2010-09-09"
Description: Launch EC2 (Amazon Linux 2023), install Apache, and pull index.html from S3

Parameters:
  KeyName:
    Type: AWS::EC2::KeyPair::KeyName
    Description: Select an existing EC2 Key Pair to enable SSH access

  BucketName:
    Type: String
    Description: Enter the S3 bucket name created in Stack-1 (Output)

  SubnetId:
    Type: AWS::EC2::Subnet::Id
    Description: Select a PUBLIC subnet (default VPC public subnet recommended)

  VpcId:
    Type: AWS::EC2::VPC::Id
    Description: Select the VPC (default VPC recommended)

Resources:
  WebServerRole:
    Type: AWS::IAM::Role
    Properties:
      AssumeRolePolicyDocument:
        Version: "2012-10-17"
        Statement:
          - Effect: Allow
            Principal:
              Service: ec2.amazonaws.com
            Action: sts:AssumeRole
      Policies:
        - PolicyName: S3ReadOnlyForWebsiteBucket
          PolicyDocument:
```

```
        Version: "2012-10-17"
        Statement:
         - Effect: Allow
           Action:
            - s3:GetObject
            - s3:ListBucket
           Resource:
            - !Sub "arn:aws:s3:::${BucketName}"
            - !Sub "arn:aws:s3:::${BucketName}/*"

WebServerInstanceProfile:
  Type: AWS::IAM::InstanceProfile
  Properties:
    Roles:
     - !Ref WebServerRole

WebServerSG:
  Type: AWS::EC2::SecurityGroup
  Properties:
    GroupDescription: Allow SSH (22) and HTTP (80)
    VpcId: !Ref VpcId
    SecurityGroupIngress:
     - IpProtocol: tcp
       FromPort: 22
       ToPort: 22
       CidrIp: 0.0.0.0/0
     - IpProtocol: tcp
       FromPort: 80
       ToPort: 80
       CidrIp: 0.0.0.0/0

WebServerInstance:
  Type: AWS::EC2::Instance
  Properties:
    InstanceType: t2.micro
    KeyName: !Ref KeyName
    SubnetId: !Ref SubnetId
    SecurityGroupIds:
     - !Ref WebServerSG
    IamInstanceProfile: !Ref WebServerInstanceProfile

    # Amazon Linux 2023 AMI for Mumbai (ap-south-1)
    ImageId: ami-02b49a24cfb95941c

    UserData:
      Fn::Base64: !Sub |
       #!/bin/bash
       dnf update -y
       dnf install -y httpd
       systemctl enable httpd
       systemctl start httpd
```

```
      # pull index.html from S3 to Apache web root
      aws s3 cp s3://${BucketName}/index.html /var/www/html/index.html

      systemctl restart httpd

Outputs:
 WebsiteURL:
   Description: Open this URL in browser
   Value: !Sub "http://${WebServerInstance.PublicDnsName}"
```

Step 3.2: Create stack

CloudFormation → Stacks → Create stack

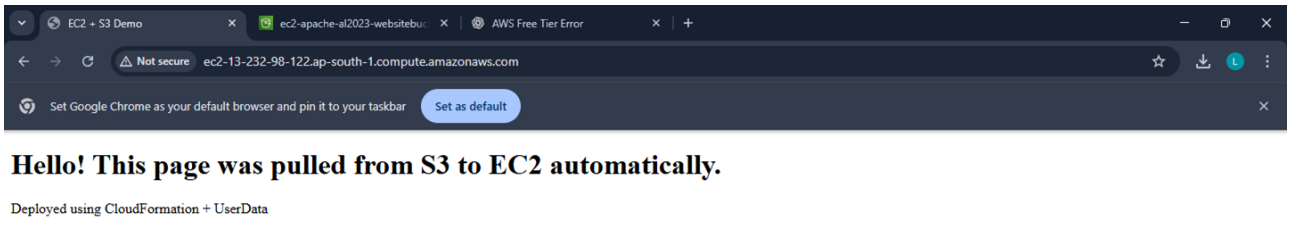
- Upload template → stack2-ec2-pull-from-s3.yaml
- Stack name: EC2-Pull-S3-Website
- Parameters:
    - **KeyName**: select your key pair (e.g., pemkeypair)
    - **BucketName**: paste bucket name from Stack-1 Output
    - **VpcId**: select **default VPC**
    - **SubnetId**: select a **PUBLIC subnet** in default VPC
      (usually the subnet name shows "public" or you can pick any default subnet that gives public IP; default subnets generally work)

Create stack → wait for **CREATE_COMPLETE**

PART 4 — Verify Output

Stack-2 → **Outputs** → copy **WebsiteURL** → open in browser.

✅ Expected page:
"Hello! This page was pulled from S3 to EC2 automatically…"



Troubleshooting (common)

1) Website not opening

- Wait 1–2 minutes (UserData takes time)
- Ensure Security Group has **HTTP 80 open**
- Ensure you selected a **public subnet** (needs internet to reach S3)

2) Stack-2 fails with S3 access error

- BucketName typed wrong
- index.html not uploaded at root of bucket

Clean-up

Delete Stack-2 first

CloudFormation → select EC2-Pull-S3-Website → Delete

Empty the S3 bucket

S3 → bucket → delete index.html (empty bucket)

Delete Stack-1

CloudFormation → select S3-Website-Bucket → Delete

Viva-ready questions

1. What is the purpose of **UserData** in EC2?
2. Why do we need an **IAM Role + Instance Profile**?
3. Why is S3 bucket not made public in this lab?
4. What happens when a CloudFormation stack is deleted?
5. Which ports are required for web hosting and SSH?

DATE: 19-12-25

Exercise–24: AWS Lambda: Input Processing, Business Logic Execution, and CloudWatch Logging

Create one Lambda function that:

1. prints a welcome message
2. reads JSON input event
3. performs business logic (grade calculation)
4. writes logs → view them in CloudWatch Logs

Yes — this is the **first combined Lambda lab exercise** (basics + input + logic + logging). Below is a

complete step-by-step procedure using **AWS Console**.

Create the Lambda Function

Step 1: Open Lambda

AWS Console → Search Lambda → Open AWS Lambda

Step 2: Create function

Click Create function

- Select - Author from scratch
- Function name: StudentGradeLogger
- Runtime: Python 3.11
- Architecture: x86_64 (default)

Step 3: Permissions (Execution Role)

Under "Permissions"

- Choose: Create a new role with basic Lambda permissions

This automatically gives permission to write logs to CloudWatch.

Click **Create function**

Add Code (Business Logic + Logs)

Step 4: Paste this code

In **Code** tab → lambda_function.py → paste and **Deploy**

```
import json

def lambda_handler(event, context):
    # Welcome message
    print("Lambda invoked successfully")

    # Read input from event
    student_name = event["StudentName"]
    marks = event["Marks"]

    # Business logic: grade calculation
    if marks >= 75:
        result = "Pass"
        grade = "A"
    else:
        result = "Fail"
        grade = "F"

    # Log output
    print("Student:", student_name)
    print("Marks:", marks)
    print("Grade:", grade)
    print("Result:", result)

    # Return response
    return {
        "statusCode": 200,
        "body": json.dumps({
            "StudentName": student_name,
            "Marks": marks,
            "Grade": grade,
            "Result": result
```

```
    })
  }
```

Click **Deploy**.

Test with Input Events (JSON)

Step 5: Create a test event (Valid case)

Go to Test (top right) → Configure test event

- Event name: ValidInput
- Paste this JSON:

```
{
 "StudentName": "Anita",
 "Marks": 86
}
```

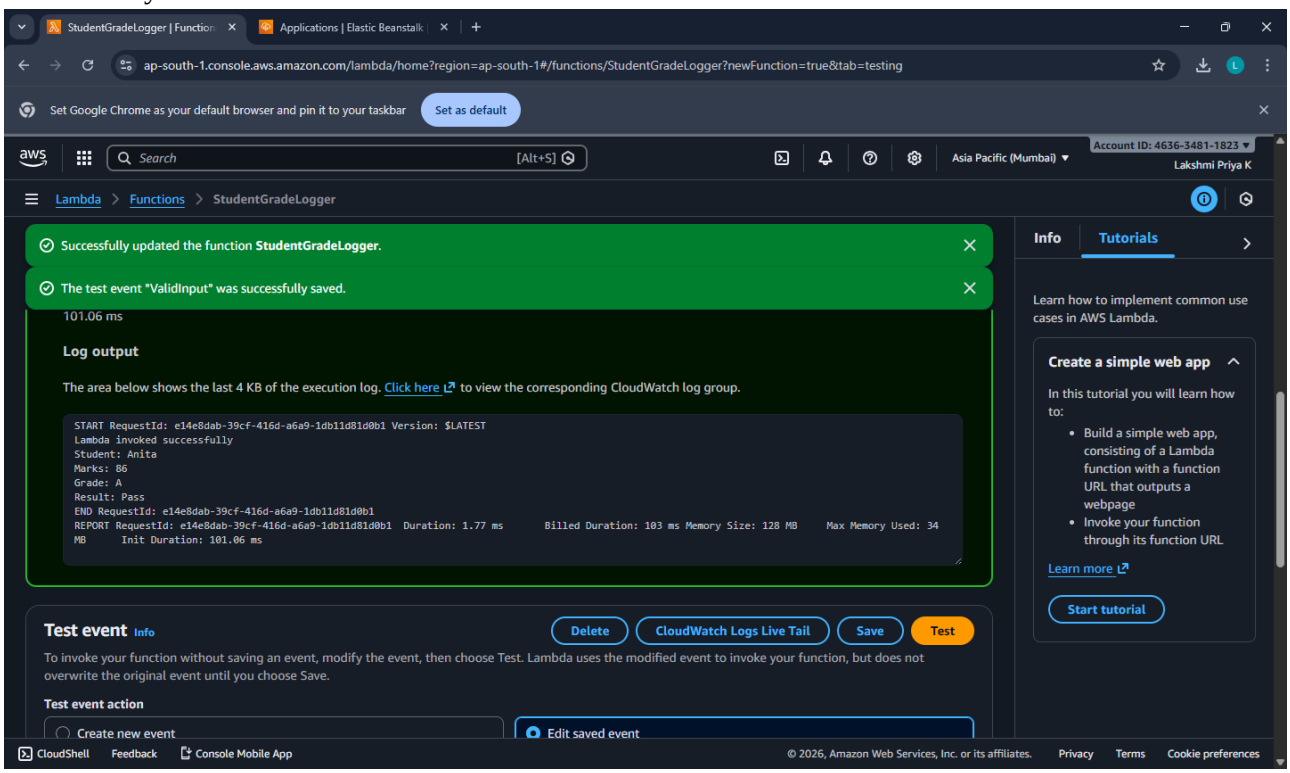
Click **Save**

Step 6: Run test

Click **Test**

Expected response (sample):

- statusCode: 200
- body will include Grade A and Result Pass



Step 7: Test invalid input (Missing Marks)

Create another test event:

- Event name: MissingMarks

```
{
 "StudentName": "Rahul"
}
```

Run **Test**

Expected:

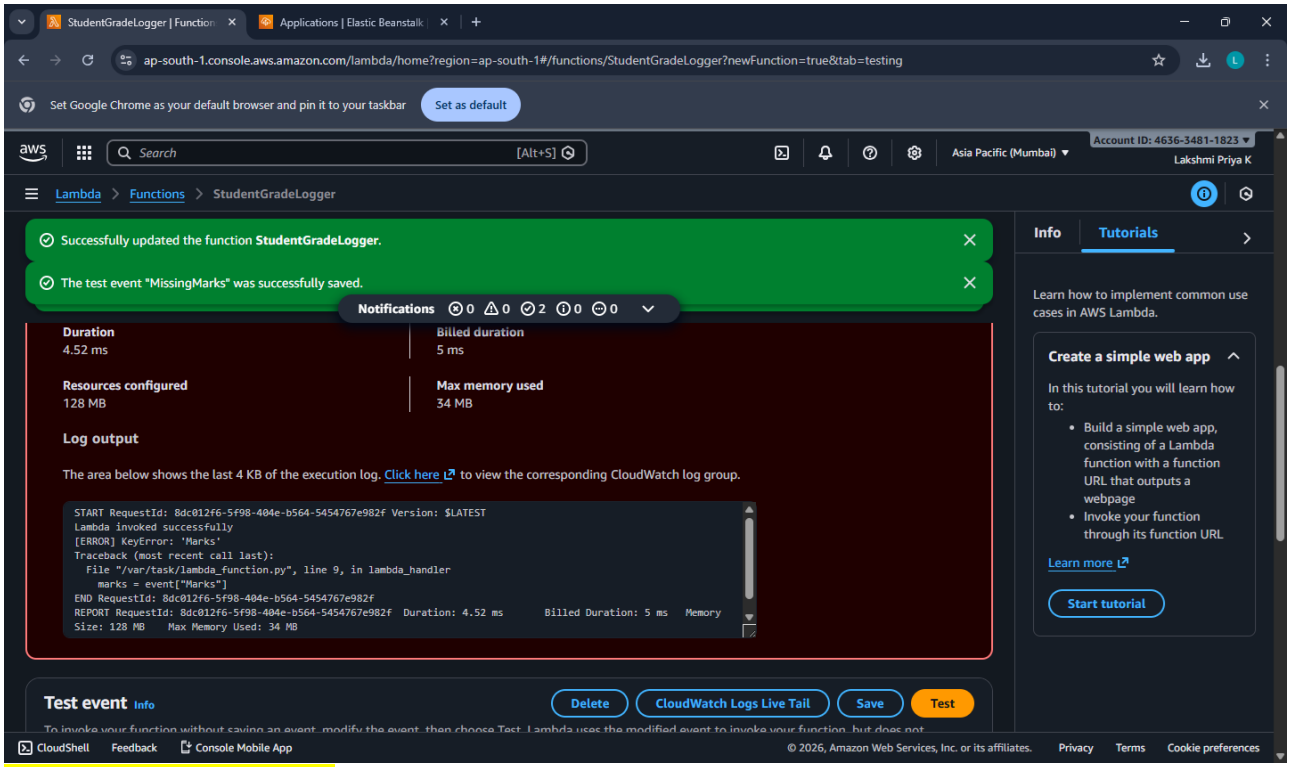
- statusCode: 400
- message: Missing 'Marks'

Step 8: Test invalid marks range
Event name: InvalidMarks

```
{
  "StudentName": "Priya",
  "Marks": 150
}
```

Expected:

- statusCode: 400
- message: Marks must be 0–100



View Logs in CloudWatch

Step 9: Open logs from Lambda directly
On the Lambda function page:

- Go to **Monitor** tab
- Click **View CloudWatch logs**

You will see:

- Log group: /aws/lambda/StudentGradeLogger
- Open latest **log stream**
- You should see all print() outputs:
  - "Lambda invoked successfully!"
  - "Received event…"
  - grade/result logs
  - error logs for invalid tests

Cleanup (Avoid charges, keep account clean)
Lambda itself usually costs nothing in small use, but cleanup is good practice:

1. Lambda → Functions → select StudentGradeLogger → **Delete**

2. CloudWatch → Log groups → find /aws/lambda/StudentGradeLogger → **Delete**
3. IAM role created (optional):
    - IAM → Roles → search role name created for Lambda → delete (only if not used elsewhere)

DATE: 24-12-25

Exercise–25: Mini Project: Event-Driven Notification System using AWS Lambda and Amazon SNS. Simulating real-time alerts from events using serverless computing.

- An event in JSON format is given as input to an AWS Lambda function.
- The Lambda function processes the event and generates a notification message.
- The message is published to an Amazon SNS topic.
- SNS sends the notification to the subscribed email address.
- The execution details are verified using CloudWatch Logs.

Create SNS Topic + Email Subscription

Step 1: Open SNS

AWS Console → Search SNS → Open Simple Notification Service

Step 2: Create a Topic

SNS → Topics → Create topic

- Type: Standard
- Name: NotificationTopic

  Click Create topic

Step 3: Copy Topic ARN

Open the created topic → copy Topic ARN

(You will paste it into Lambda code later)

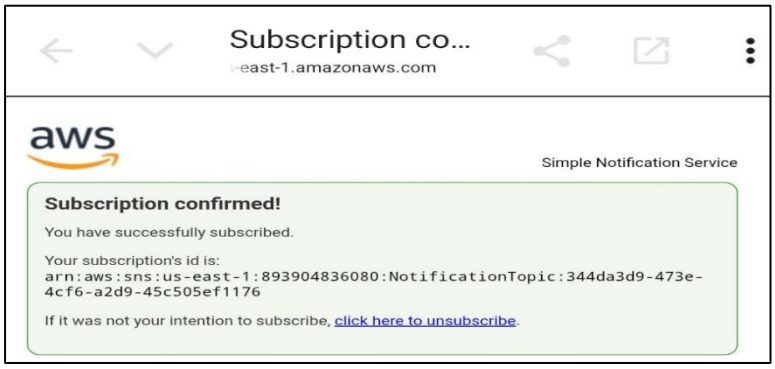
Step 4: Create an Email Subscription

Inside the same topic:

Click Create subscription

- Protocol: Email
- Endpoint: (your email id)

  Click Create subscription



Step 5: Confirm Subscription

Open your email inbox → find AWS SNS confirmation mail → click Confirm subscription → Status in SNS should become Confirmed.

Create Lambda Function

Step 6: Open Lambda

AWS Console → Search Lambda → Open AWS Lambda

Step 7: Create function

Click Create function

- Select: Author from scratch
- Function name: NotificationSimulator
- Runtime: Python 3.11
- Permissions: Create a new role with basic Lambda permissions
  Click Create function

Add Lambda Code (with SNS Publish)

Step 8: Paste code in lambda_function.py

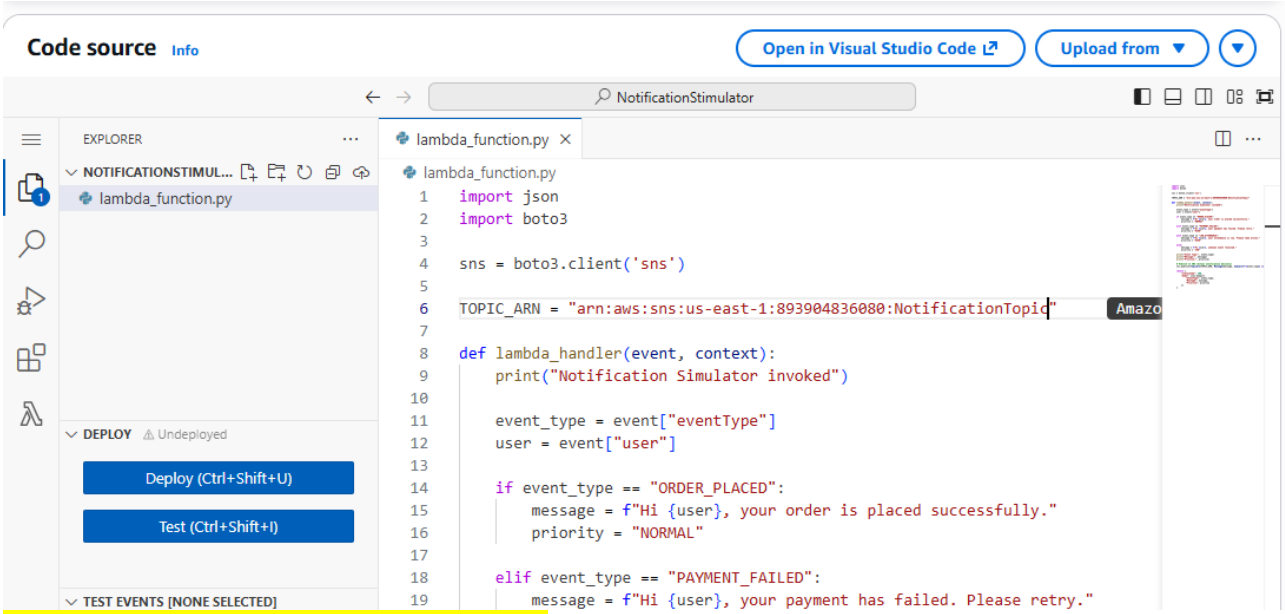
Lambda → **Code** tab → open lambda_function.py → remove existing code → paste:

Replace <SNS_TOPIC_ARN> with your copied Topic ARN.

```
import json
import boto3

sns = boto3.client('sns')

TOPIC_ARN = "<SNS_TOPIC_ARN>"

def lambda_handler(event, context):
    print("Notification Simulator invoked")

    event_type = event["eventType"]
    user = event["user"]

    if event_type == "ORDER_PLACED":
        message = f"Hi {user}, your order is placed successfully."
        priority = "NORMAL"

    elif event_type == "PAYMENT_FAILED":
        message = f"Hi {user}, your payment has failed. Please retry."
        priority = "HIGH"

    elif event_type == "LOW_ATTENDANCE":
        message = f"Hi {user}, your attendance is low. Please take action."
        priority = "HIGH"

    else:
        message = f"Hi {user}, unknown event received."
        priority = "LOW"

    print("Event Type:", event_type)
    print("Message:", message)
    print("Priority:", priority)

    # Publish to SNS (Actual notification delivery)
    sns.publish(TopicArn=TOPIC_ARN, Message=message, Subject=f"{event_type} [{priority}]")

    return {
        "statusCode": 200,
        "body": json.dumps({
            "EventType": event_type,
            "Message": message,
            "Priority": priority
        })
```

```
}
```

Click **Deploy**
Wait for "Successfully updated function…"



Give Lambda Permission to Publish to SNS

Step 10: Open Lambda Execution Role
Lambda → Configuration → Permissions
Click the Role name (execution role link)

Step 11: Attach SNS Publish Policy
IAM Role page → Add permissions → Attach policies
Attach: AmazonSNSFullAccess
Click Add permissions
Now Lambda can publish to SNS.

Test the Mini Project

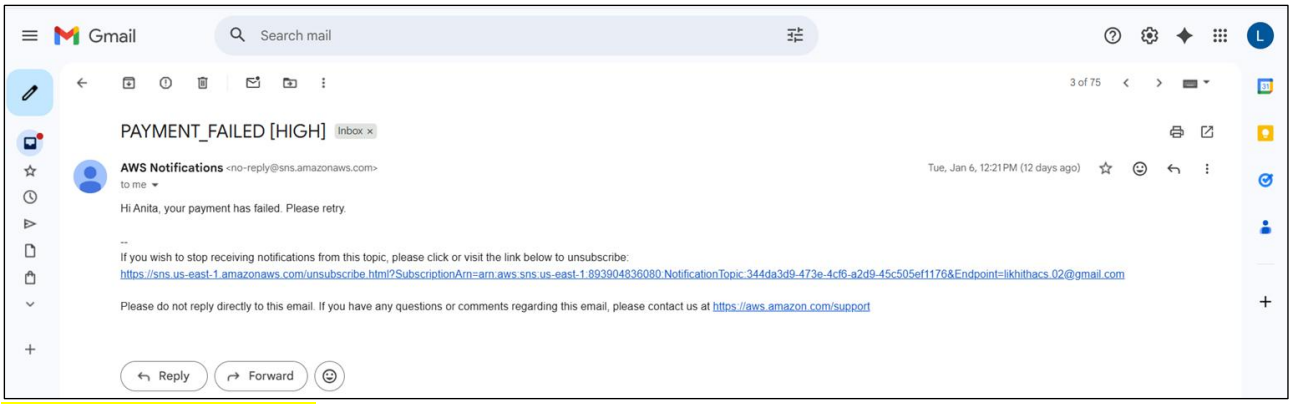
Step 12: Create a test event
Lambda → Test tab → Create new test event
Event name: PaymentFailed
Paste:

```
{
  "eventType": "PAYMENT_FAILED",
  "user": "Anita"
}
```

Click **Save**

Step 13: Run Test
Click **Test**
Expected:

- Execution: **Succeeded**
- Email should arrive within a few seconds:
  Subject like: PAYMENT_FAILED [HIGH]
  Message: "Hi Anita, your payment has failed. Please retry."

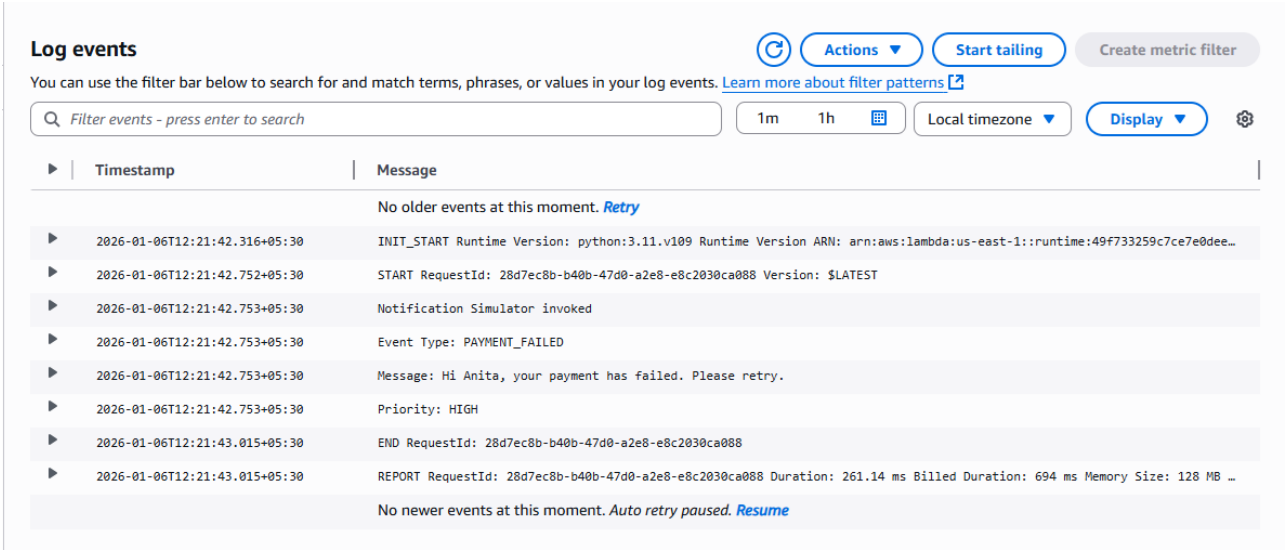


Verify CloudWatch Logs

Step 14: View logs

Lambda → Monitor → View CloudWatch logs
Open latest log stream.
Verify these prints exist:

- Notification Simulator invoked
- Event Type:
- Message:
- Priority:



Expected Outputs

1. Lambda test status: Succeeded
2. Email received from SNS with correct message
3. CloudWatch logs showing event type and generated message

Cleanup

1. Delete Lambda function: NotificationSimulator
2. SNS → delete topic NotificationTopic (subscriptions removed automatically)
3. CloudWatch → delete log group for Lambda
4. (Optional) Delete IAM role if not used elsewhere

DATE: 26-12-25

Exercise–26: Analyze a CSV File in S3 Using Amazon Athena (No Server)

Upload a small CSV to **S3**, then use Athena to run SQL queries like count, average, max, group by.

Part A — Create Sample CSV (on your PC)

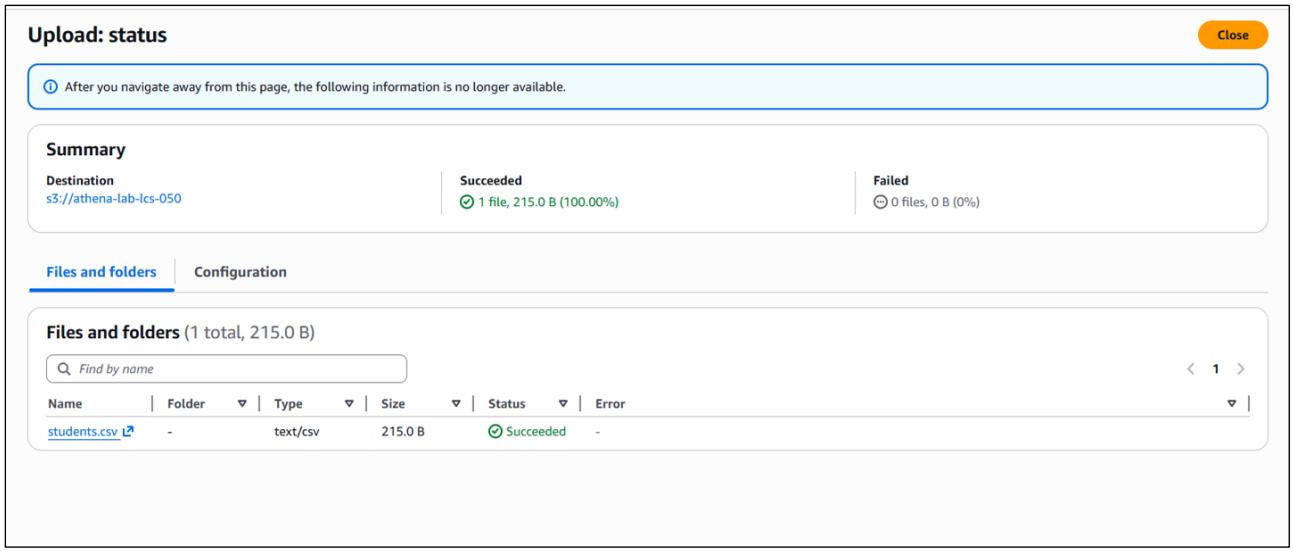
1. Open **Notepad**
2. Paste this data and save as: **students.csv**

```
StudentID,Name,Dept,Marks,Result
101,Anita,MCA,85,Pass
102,Ravi,MCA,72,Pass
103,Meera,MBA,64,Pass
104,John,MCA,35,Fail
105,Sneha,MBA,91,Pass
106,Arun,MCA,49,Fail
107,Kiran,MBA,58,Pass
108,Divya,MCA,77,Pass
```

Part B — Create S3 Bucket and Upload CSV

1. Go to **AWS Console → S3**
2. Click **Create bucket**
3. Bucket name: athena-lab-<yourname>-<number> (must be globally unique)
4. Keep defaults → Click **Create bucket**
5. Open the bucket → Click **Upload**
6. Upload **students.csv**
7. Click **Upload**

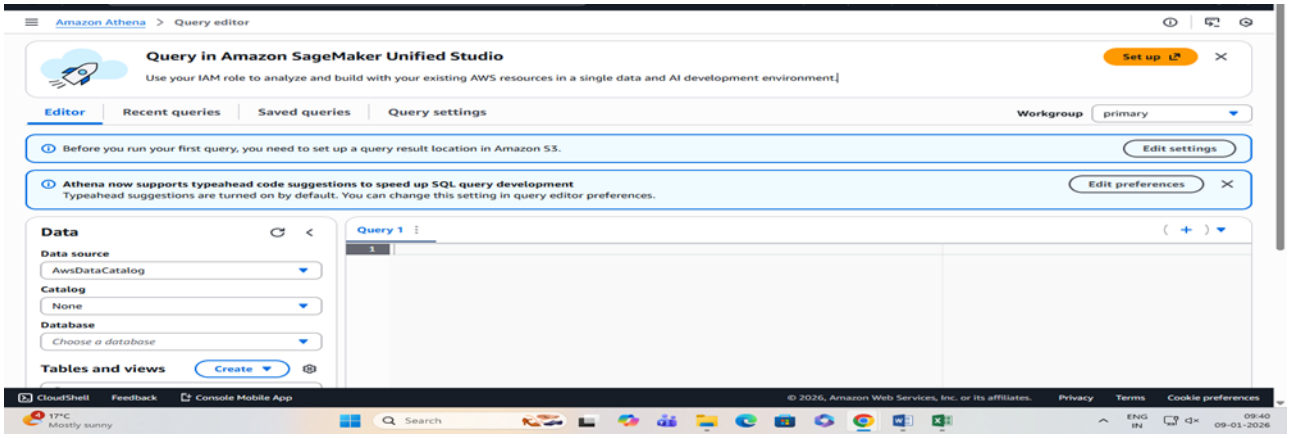
Now your CSV is in S3.



Part C — Open Athena and Set Query Result Location (IMPORTANT)

1. Go to **AWS Console → Amazon Athena**
2. If it shows "Get started" / "Query editor", open it.
3. It will ask to set a **Query result location**
4. Click the link/button like **Settings / Manage / Edit**
5. Set query result location to something like:
    - s3://your-bucket-name/athena-results/
6. Click **Save**

This is required so Athena can store query outputs.



Part D — Create a Database in Athena

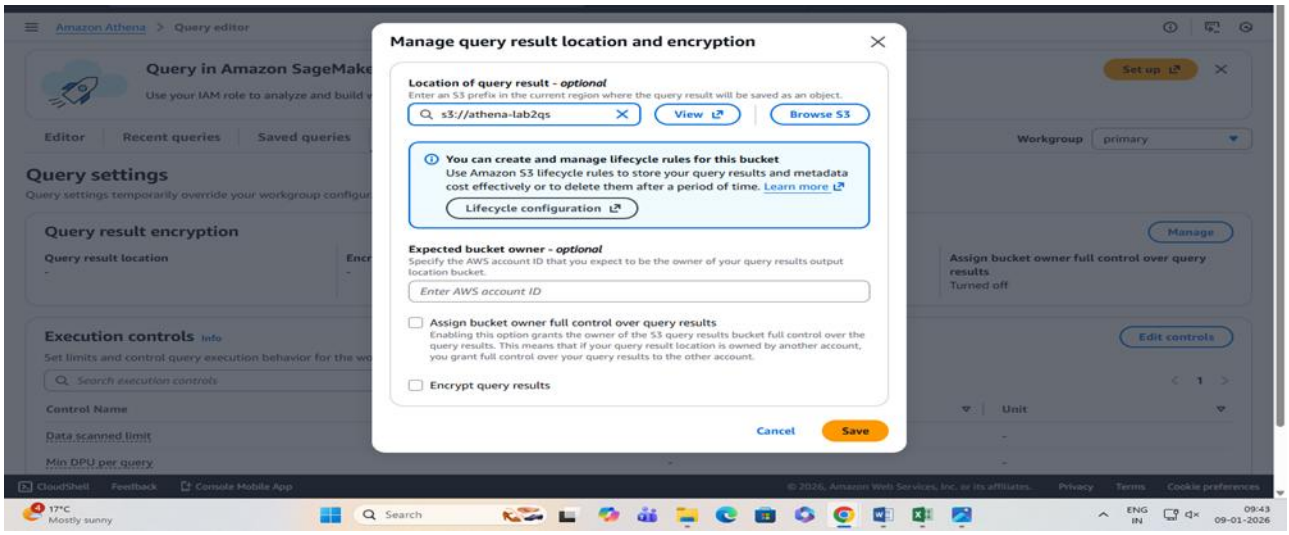
In Athena query editor, run:

CREATE DATABASE labdb;

Then on the left side, select:

- **Data source:** AwsDataCatalog

- **Database:** labdb



Part E — Create a Table for the CSV in S3

Run this (replace YOUR_BUCKET_NAME with your actual bucket name):

```
CREATE EXTERNAL TABLE IF NOT EXISTS students (
  StudentID int,
  Name string,
  Dept string,
  Marks int,
  Result string
)
ROW FORMAT SERDE 'org.apache.hadoop.hive.serde2.OpenCSVSerde'
WITH SERDEPROPERTIES (
  'separatorChar' = ',',
  'quoteChar'     = '"',
  'escapeChar'    = '\\'
)
STORED AS TEXTFILE
LOCATION 's3://YOUR_BUCKET_NAME/'
TBLPROPERTIES ('skip.header.line.count'='1');
```

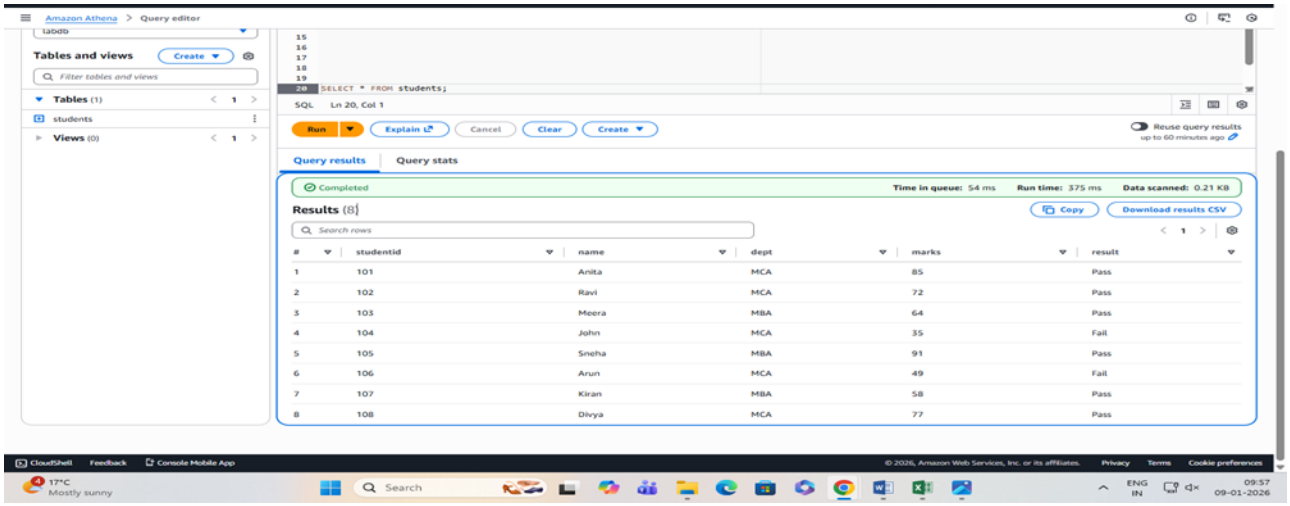
This tells Athena: “My CSV is in S3, treat it like a table.”

Part F — Run Simple Analysis Queries (Core Part)

1) View all rows

SELECT * FROM students;

Expected: 8 records.



2) Total students

SELECT COUNT(*) AS total_students FROM students;

Expected: 8

3) Pass vs Fail count

SELECT Result, COUNT(*) AS cnt

FROM students

GROUP BY Result;

Expected (based on data): Pass = 6, Fail = 2

4) Average marks overall

SELECT AVG(Marks) AS avg_marks

FROM students;

5) Department-wise average marks

SELECT Dept, AVG(Marks) AS avg_marks

FROM students

GROUP BY Dept;

6) Top scorer

SELECT Name, Dept, Marks

FROM students

ORDER BY Marks DESC

LIMIT 1;

Expected: Sneha (91)

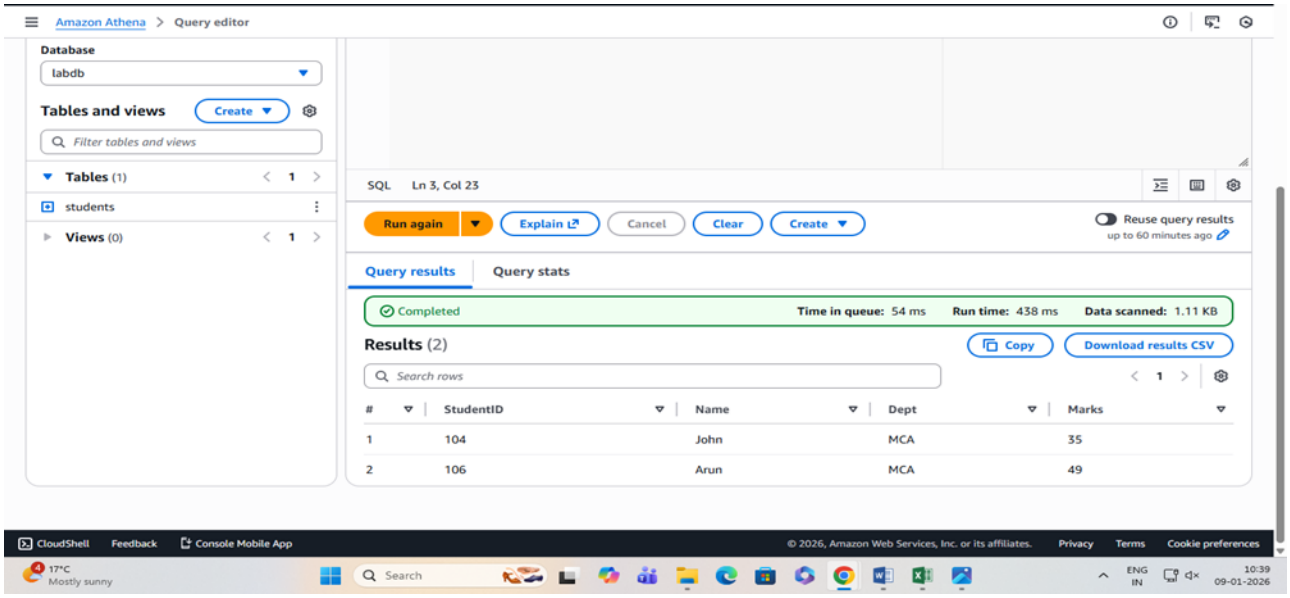
7) List failed students

SELECT StudentID, Name, Dept, Marks

FROM students

WHERE Result = 'Fail';

Expected: John, Arun



Cleanup (to avoid any charges)

1. In Athena, you can keep DB/table (no cost by itself), but clean S3:
2. Go to **S3 bucket**
3. Delete:
    - students.csv
    - athena-results/ folder contents (query outputs)
4. Delete the bucket (must be empty to delete)

Cost Note (Simple)

- **S3 storage**: tiny (almost negligible for this)
- **Athena**: charges based on **data scanned**; with this tiny CSV it's usually minimal, but **always delete outputs and bucket** after lab.