

Assignment 2

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Abstract- This report outlines the process of creating a photo album using Amazon Web Services (AWS). Along with the photo album developed in Assignment 1b, the deployment of this album makes use of a number of AWS features, including Lambda, SNS, and load balancing. This report includes a thorough, step-by-step breakdown of how this album was created, along with a list of the resources utilized and the information entered into them for clarity.

I. INTRODUCTION

For this task, the cloud infrastructure model of Amazon Web Services (AWS) was selected. We have added more AWS services to the functionality to improve the features of the album which should be already created using a single Web Server instance to deliver a photo album in the prior assignment. Adding photographs to the album in the prior assignment required uploading them to an S3 bucket and manually entering the photos' metadata into a PHP database. In this project, we have overcome this difficulty and changed the photo album into a service that is very accessible.

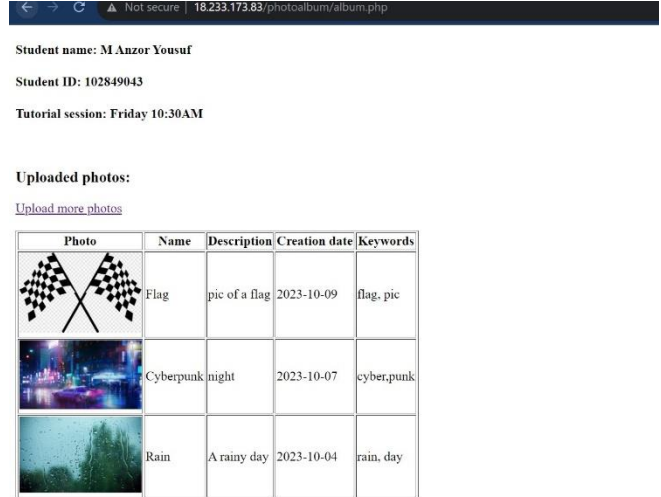
The following AWS and third-party resources were employed in this assignment:

- AWS VPC
- AWS EC2
- AWS RDS
- AWS S3
- PHPMyAdmin
- AWS IAM
- NAT Gateway
- AWS Lambda
- AWS Load Balancer (LB)
- AWS Simple Notification Service (SNS)

The photo album is now successfully hosted and accessible.

Here is the link to the page:

<http://assignment2-580627140.us-east-1.elb.amazonaws.com/photoalbum/album.php>



The screenshot shows a web browser window with the URL 18.233.173.83/photoalbum/album.php. The page displays student information: Student name: M Anzor Yousuf, Student ID: 102849043, and Tutorial session: Friday 10:30AM. Below this, there is a section for 'Uploaded photos' with a link to 'Upload more photos'. A table lists the uploaded photos with columns for Photo, Name, Description, Creation date, and Keywords.




Photo	Name	Description	Creation date	Keywords
	Flag	pic of a flag	2023-10-09	flag, pic
	Cyberpunk	night	2023-10-07	cyber.punk
	Rain	A rainy day	2023-10-04	rain, day

Fig.1- Final Photo Album Database

II. ASSIGNMENT SPECIFICATIONS

This assignment extends a previous photo album project. Like before, it employs a single VPC with two Availability Zones, each containing public and private subnets. The public subnets have internet access through an Internet Gateway. Public Subnet 2 hosts a Dev Server for configuring the PHP database that stores photo metadata. Public Subnet 1 has a NAT gateway that enables instances in private subnets to communicate externally.

To enhance availability and handle high traffic, Amazon Load Balancing is implemented. Web Servers, based on the Dev Server template, host the photo album. Auto scaling configurations ensure that if Web Servers become inaccessible or fail, new instances are automatically created to maintain high availability.

Furthermore, you can now add photos to the album directly from a web URL using AWS Lambda. Lambda, with pre-existing code, automatically resizes uploaded images, adds them to the database, and stores them in an S3 bucket. AWS SNS is also configured to assist in this deployment.

Walkthrough of the whole process

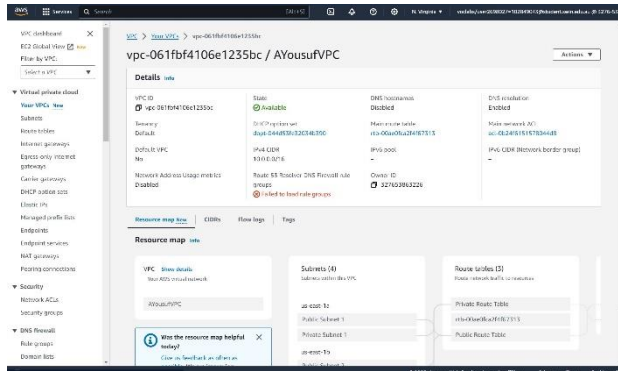


Figure 2: Creation of VPC

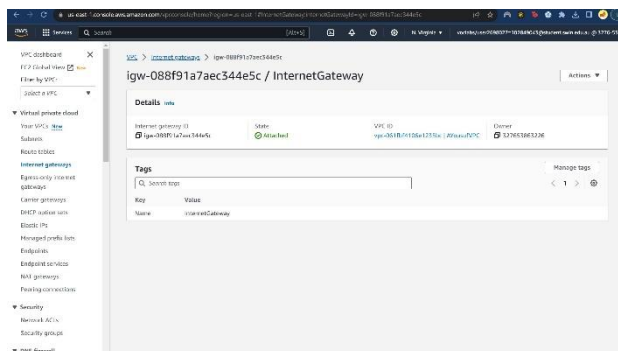


Figure 3: Linking of IGW to VPC

In Figure 2, a Virtual Private Cloud (VPC) named "AYousofVPC" has been established with the CIDR notation of 10.0.0.0/16. As depicted in Figure 3, an internet gateway has been set up and connected to the VPC.

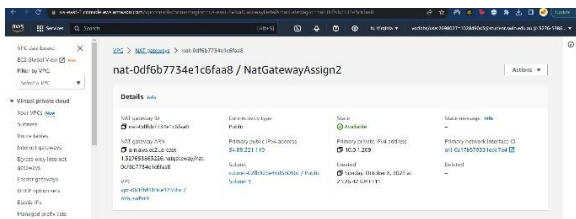


Figure 4: Nat Gateway

In order to enable internet access, two routing tables have been set up. The routing table named "Private Route Table" has been assigned to manage the two public subnets and includes an Internet Gateway. As for the two private subnets, the routing table "Private Routing Table" has been configured to route traffic through a NAT gateway.

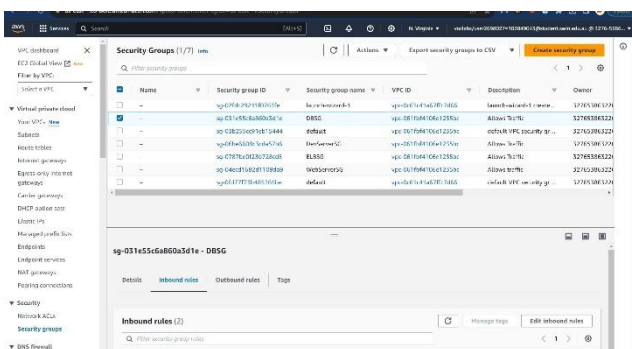


Figure 5: Security Groups

As shown in Figure 5, 4 security groups, WebServer SG, DBSG, ELBSG and DevServerSG were created with the inbound rules mentioned.

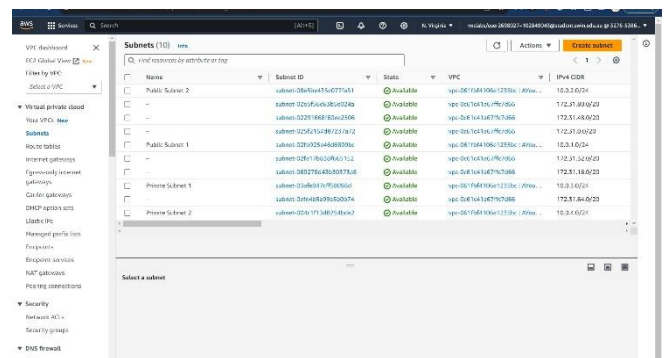


Figure 6: Subnets

Two separate subnets have been established in each availability zone to segregate distinct resources. Each subnet is assigned its own CIDR block for IP address allocation:

Public Subnet 1: 10.0.1.0/24

Private Subnet 1: 10.0.3.0/24

Public Subnet 2: 10.0.2.0/24

Private Subnet 2: 10.0.4.0/24

Public Subnet 2 has been designated as the hosting location for the web server, granting accessibility from anywhere on the internet. Consequently, it has been assigned a custom Routing Table which incorporates the Internet Gateway to establish communication with the internet.

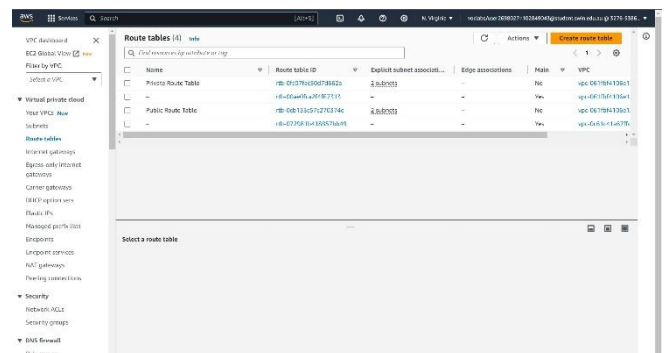


Figure 7: Route Tables

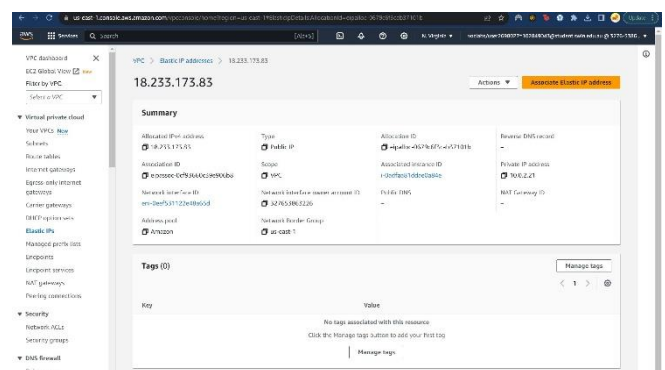


Figure 8: Elastic IPs

A unique Elastic Public IP address has been generated exclusively for the Web Server instance. This IP address is automatically assigned and reserved, ensuring a consistent and unchanging URL for connecting to the Web Server while maintaining DNS stability.

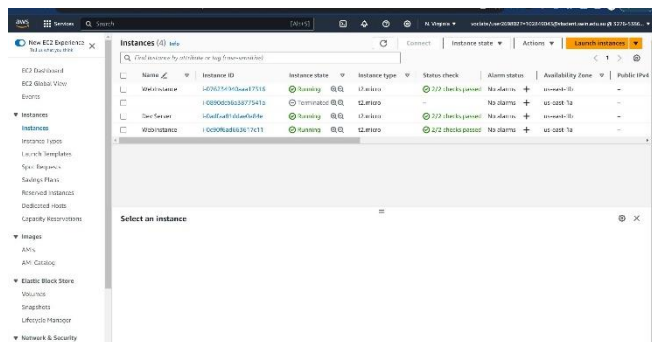


Figure 9: Instances

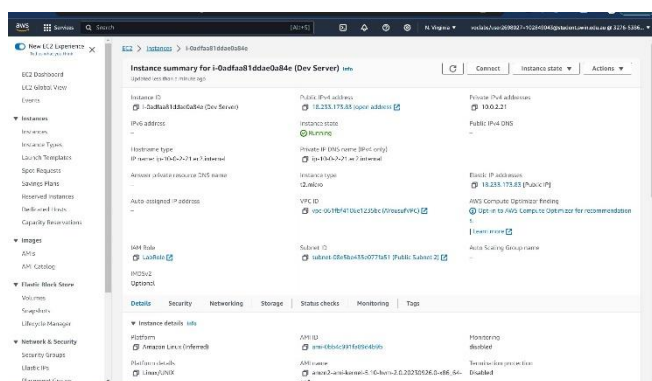


Figure 10: Dev Server

An Amazon EC2 Development Server has been established in Public Subnet 2 within the VPC. Its primary purpose is to configure the PHP database using PHPMyAdmin and serve as a template for upcoming Web Servers. To ensure consistent accessibility, the Dev Server has been associated with an Elastic IP Address.

For security, the previously defined DevServerSG security group has been assigned to permit incoming traffic, including SSH connections, to the instance. Furthermore, the LabRole IAM role has been assigned to this server, granting it specific permissions for future Lambda functions.

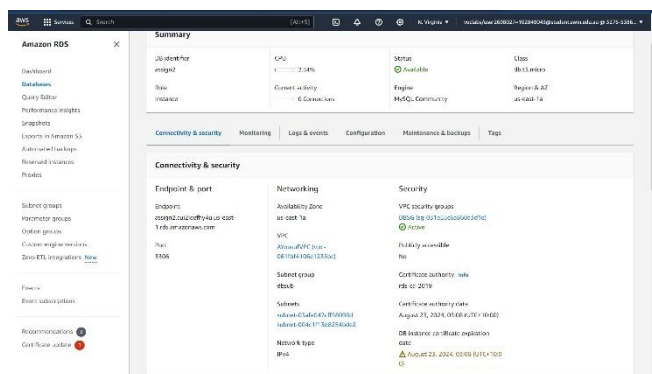


Figure 11: Amazon RDS

a Relational Database Service (RDS) has been set up, utilizing MySQL version 8.0.34 and adopting the Free Tier

template. This RDS instance is assigned to the "AYousufVPC" and utilizes the recently created Subnet Group known as "dbsub". It is located within Availability Zone LA. Security access is granted through the "DBServerSG" security group, which was generated during the second phase of the process.

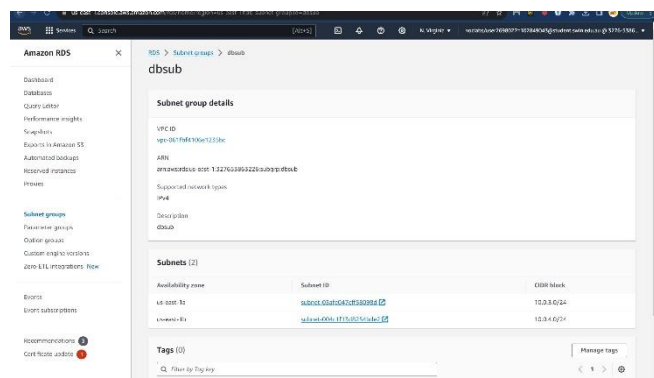


Figure 12: Subnet groups

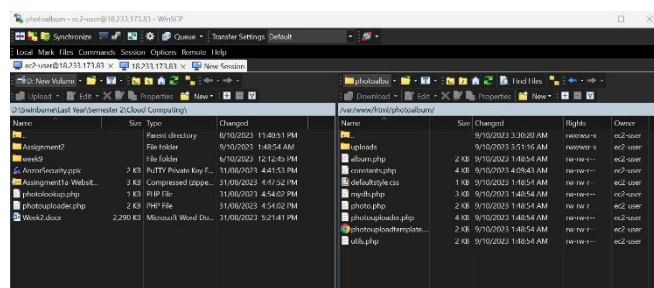


Figure 13: File transferring through WinSCP

The configuration of PhpMyAdmin and the terminal involved establishing a connection to the Web Server using PuTTY, a Linux terminal application. This connection was made possible by using the Elastic IP address allocated to this specific instance, serving as the Public IP address. The terminal was employed to execute commands necessary for completing the configuration of PhpMyAdmin.

WinSCP facilitated the process of transferring and editing files. Establishing a connection between the Web Server and the configuration file required modifying the localhost endpoint data of the RDS database.

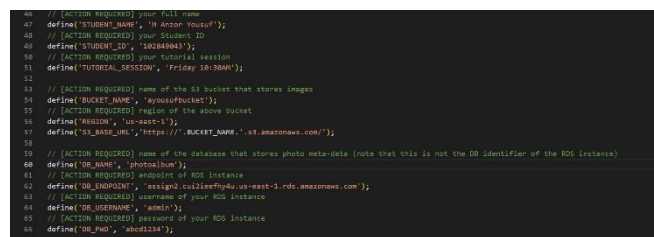


Figure 14: Replacing hostname

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	Title	varchar(255)	utf8mb4_0900_ai_ci		No	None			Change Drop More
2	Description	varchar(255)	utf8mb4_0900_ai_ci		No	None			Change Drop More
3	Date	date			No	None			Change Drop More
4	Keyword	varchar(255)	utf8mb4_0900_ai_ci		No	None			Change Drop More
5	Reference	varchar(255)	utf8mb4_0900_ai_ci		No	None			Change Drop More

Figure 15: Table Structure

Changes have been made to the constants.php file to incorporate the pertinent information required to finish the deployment process.

```

68 // (ACTION REQUIRED) name of the DB table that stores photo's meta-data
69 define('DB_PHOTO_META_NAME', 'photosmeta');
70 // The table above has 5 columns
71 // (ACTION REQUIRED) name of the column in the above table that stores photo's titles
72 define('DB_PHOTO_TITLE_COL_NAME', 'title');
73 // (ACTION REQUIRED) name of the column in the above table that stores photo's descriptions
74 define('DB_PHOTO_DESCRIPTION_COL_NAME', 'description');
75 // (ACTION REQUIRED) name of the column in the above table that stores photo's creation dates
76 define('DB_PHOTO_CREATIONDATE_COL_NAME', 'date');
77 // (ACTION REQUIRED) name of the column in the above table that stores photo's keywords
78 define('DB_PHOTO_KEYWORDS_COL_NAME', 'keywords');
79 // (ACTION REQUIRED) name of the column in the above table that stores photo's links in S3
80 define('DB_PHOTO_REFERENCE_COL_NAME', 'reference');
81
82 // (ACTION REQUIRED) name (ARN can also be used of the Lambda function that is used to create thumbnails
83 define('LAMBDA_FUNC_THUMBNAILS_NAME', 'createThumbnail');
84
85 ?>

```

Figure 16

Item	Value
AMI ID	ami-063b139343459c7
Image type	machine
Platform details	Linux/UNIX
Root device type	EBS
AMI name	aws-ec2-ami-063b139343459c7
Architecture	x86_64
Usage operations	RunInstances
Root device name	/dev/sda1
Status	Available
Source	aws-ec2-ami-063b139343459c7
Virtualization type	hvm
Boot mode	UEFI
Creation date	March 10, 2023 04:11:11 GMT+11:00 (Australia Eastern Daylight Time)
Expiration date	Never
Discontinuation time	Never
Discontinuation time	Never
Product codes	None
RAM disk (ID)	None
Block devices	/dev/sda1 (EBS), /dev/sdb (EBS)
Download metadata	Download metadata

Figure 17: AMI Image summary

Item	Value
Load balancer type	Application
Scheme	Internet
Subnet	subnet-0a1b2c3d
Availability zones	us-east-1a, us-east-1b
Creation date	October 9, 2023 04:44:07 GMT+11:00
Load balancer name	Assignment2
Load balancer ARN	arn:aws:elasticloadbalancing:us-east-1:123456789012:loadbalancer/app/Assignment2

Figure 18: Load Balancer

In the VPC, an application load balancer is installed. This is being hosted over Public Subnet 1 and Public Subnet 2, according to the configuration. The previously created security group "ELBSG" is used. For listeners and routing, it uses the target group that was just described above.

Item	Value
Auto Scaling group name	Assignment2 Auto Scaling Group
Desired capacity	2
Minimum capacity	2
Maximum capacity	3
Launch template	Launch template: lt-0a1b2c3d
Availability zones	us-east-1a, us-east-1b
Subnets	subnet-0a1b2c3d, subnet-0e1f2g3h
Security groups	sg-0a1b2c3d
Target group	tg-0a1b2c3d
Key pair	None
Discontinuation time	Never

Figure 19: Auto Scaling Group

Establishment of groups and instances with automatic scaling
An Auto Scaling Group has been set up using the Launch Template option. The VPC receives instances in Private Subnets 1 and 2. It has been linked to the target group and load balancer that were previously set up in preparation for upcoming health checks. For size configuration, the following properties have been put up:

Required: 2

Maximum: 3

Minimum: 2

This ensures that there are always at least two active web servers. It will quickly deploy a new instance if it discovers that one of the instances is broken. For the purpose of balancing traffic load, a Target Scaling Policy with a value of 30 has been configured.

Object Name	Type	Last modified	Size	Storage class
100.jpg	jpg	October 9, 2023 13:07:43 GMT+11:00	716.6 KB	Standard
1000.jpg	jpg	October 9, 2023 04:11:04 GMT+11:00	7.4 MB	Standard
10000.jpg	jpg	October 9, 2023 04:11:05 GMT+11:00	23.4 KB	Standard
100000.jpg	jpg	October 9, 2023 04:11:05 GMT+11:00	102.4 KB	Standard

Figure 20: ayousufbucket Objects

A new S3 bucket has been established for the purpose of uploading and storing objects, specifically pictures. The objects stored in this bucket are made accessible to other resources through a policy depicted in Figure 22, enabling public access to these items.

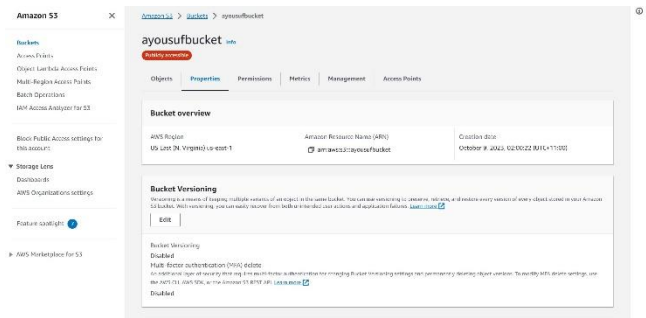


Figure 21: ayousufbucket Properties

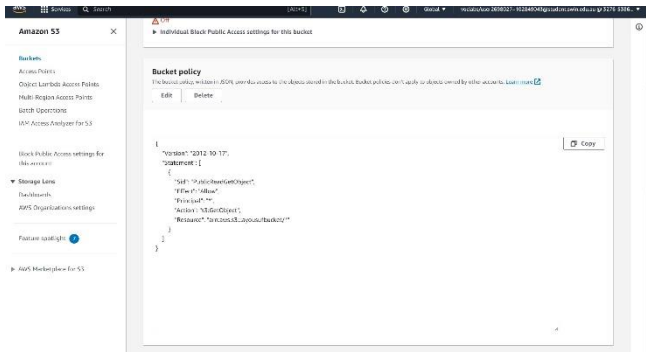


Figure 22: Bucket Policy

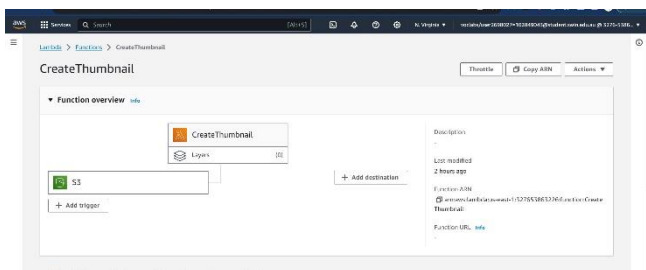


Figure 23: Lambda Function CreateThumbnail

To enable users to upload photos from the webpage to the album, we've harnessed AWS Lambda. We've established a Lambda function named "CreateThumbnail" for this purpose. This function is responsible for resizing the uploaded images and displaying them as thumbnails in the photo album. We've utilized a pre-configured code package, which has been uploaded into the Lambda function.

To facilitate the direct uploading of images to the S3 bucket, we've set up a trigger that triggers upon Object Creation in S3. This trigger is associated with a dedicated IAM role known as "LabRole." To accommodate larger files, we've extended the function's Timeout to 45 seconds.

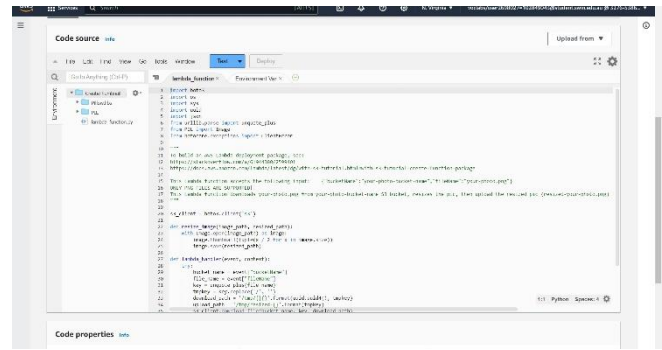


Figure 24: Lambda code deployment

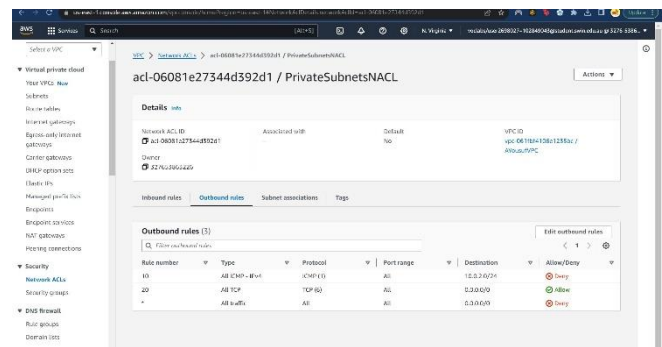


Figure 25: Outbound Rules NACL

For the webserver, a NACL was developed to increase security. It accepts traffic from various sources, including SSH, ICMP, and others. These regulations only apply to the Web Server instance because they are only valid for the public subnet 2 that the instance is located on.

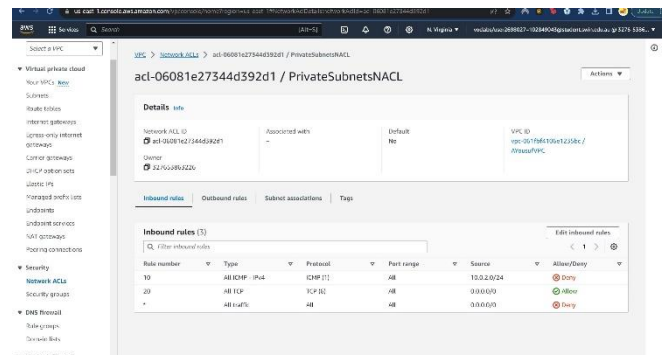


Figure 26: Inbound Rules Roles NACL

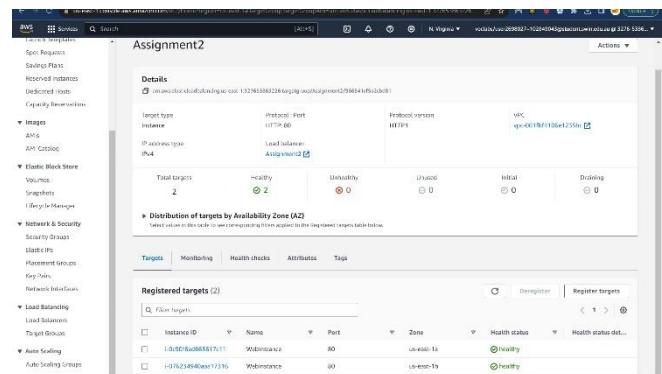


Figure 27: Target Group Menu

Routine health checks are performed on the Web Server instances using the target group to verify the well-being of

all instances. By accessing the Target Group menu, you can observe that the existing two instances are currently in good health.

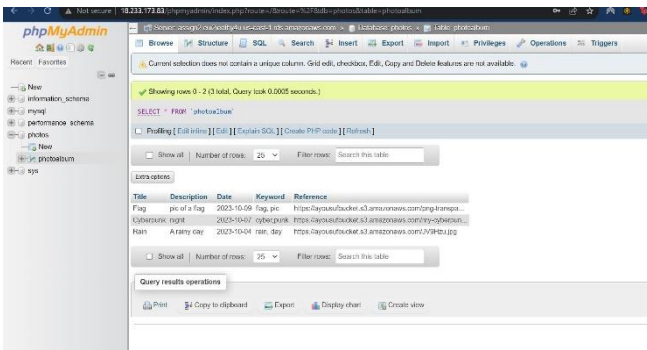


Figure 28: PHP Database

The PHP Database is also updated with all the actual images of the photo album.

III. CONCLUTION

In this assignment, we've successfully deployed a feature-rich photo album system with advanced functionalities like high availability, secure photo uploading from URLs. We set up this website initially on the Dev Server and made it exclusively accessible through the Web Servers controlled by the Load Balancer.

You can access the website through the Load Balancer's URL: <http://assignment2-580627140.us-east-1.elb.amazonaws.com/photoalbum/album.php>. To confirm that it's inaccessible from the Dev Server, you can test it using the Elastic IP address attached to the Dev Server: <http://18.233.173.83/photoalbum/album.php>.

Our website demonstrates high availability, automatically creating new instances if any Web Server goes offline, making it capable of handling unexpected spikes in traffic efficiently.

It's worth noting that since the Load Balancer is an Application Load Balancer, it doesn't support attaching an Elastic IP address. However, we've provided the DNS URL of the Load Balancer in this document for access. The report provides comprehensive details on the steps taken to set up this deployment.