COS20019 - Cloud Computing Architecture
Assignment 2
Developing a highly available Photo Album website.

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I. Introduction

Amazon Web Services (AWS) provides a comprehensive set of services that can be leveraged to build a robust and highly available photo album website. By utilizing key AWS services for storage, hosting, databases, caching, load balancing, and monitoring, we will build a highly available Photo Album website with more advanced features than the previous assignments.

II. Foundation and Infrastructure

Before moving to the deployment phase, we first need to lay the foundation for our website, namely creating VPC with accurately configured subnets according to the given Architecture diagram.

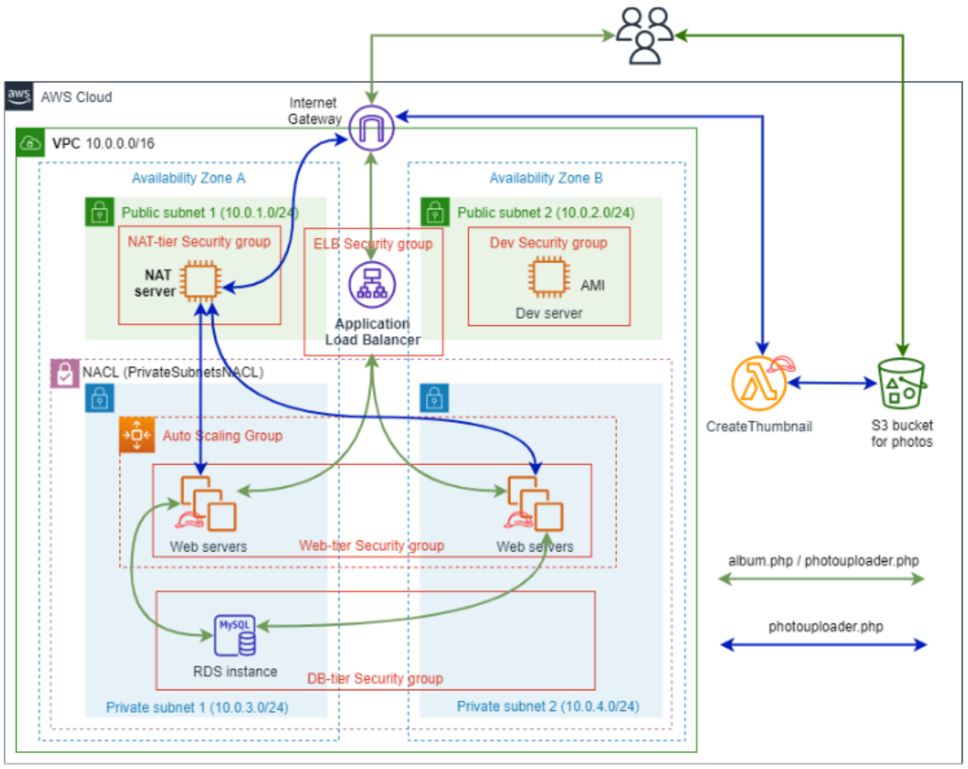


Figure 1: Architecture diagram.

This task is not so difficult as Assignment 1A and 1B has already introduced such objective. After configuring we might have a Resource map for our VPC and their according subnets as follows:

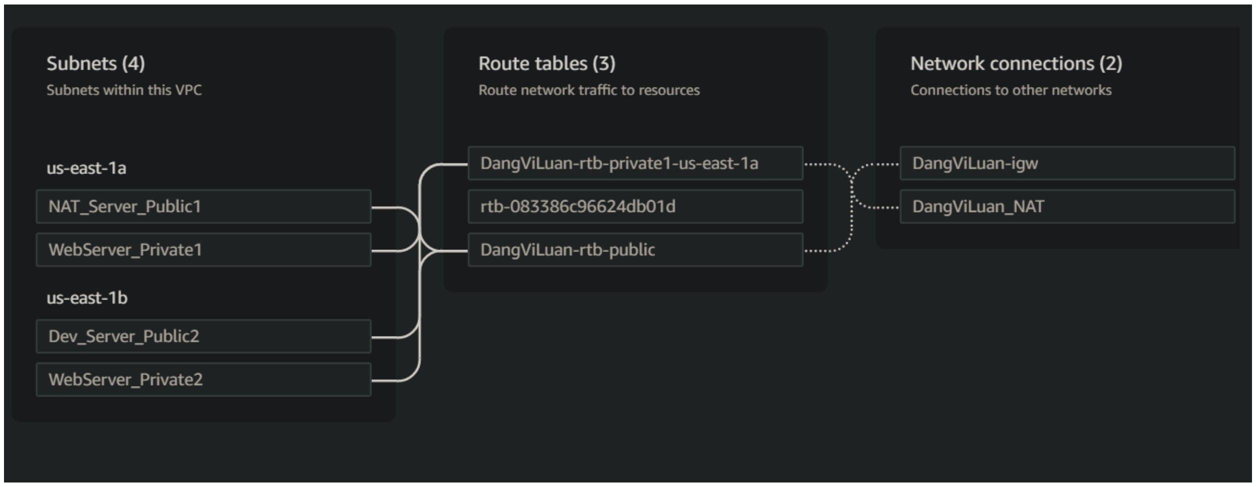
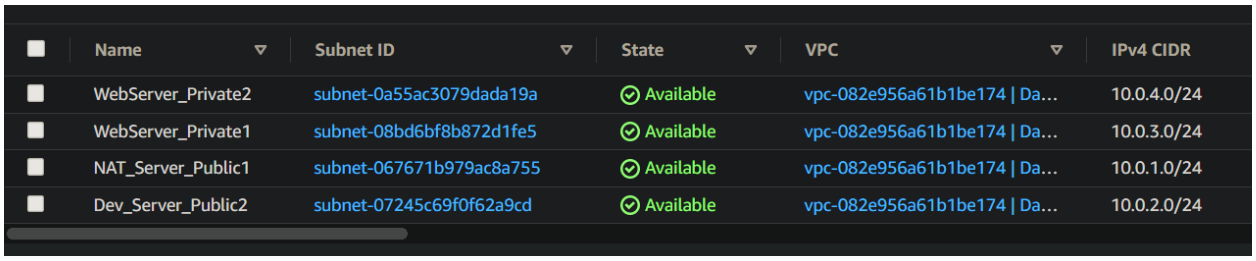


Figure 2: VPC resource map.



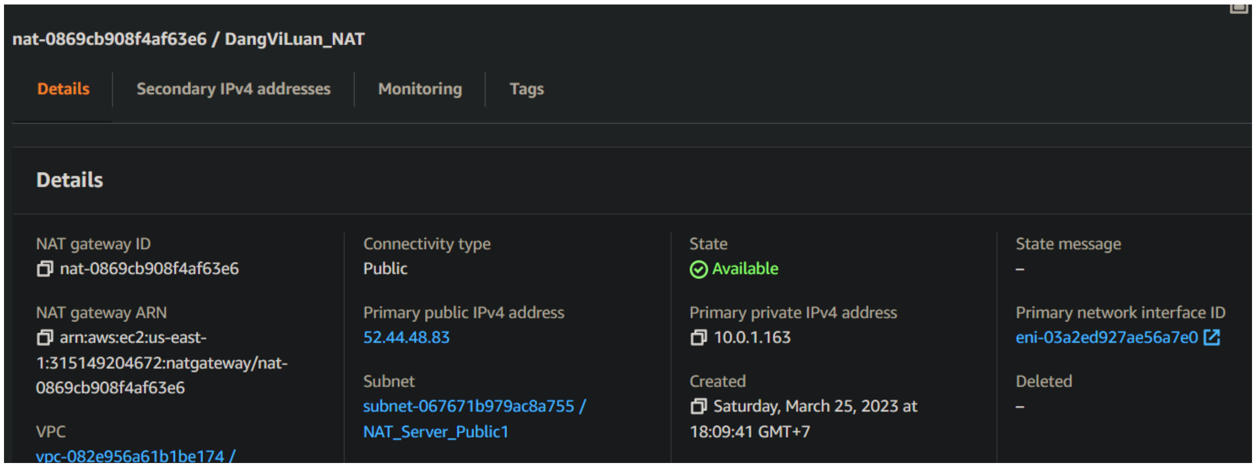
Name	Subnet ID	State	VPC	IPv4 CIDR
WebServer_Private2	subnet-0a55ac3079dada19a	Available	vpc-082e956a61b1be174 | Da...	10.0.4.0/24
WebServer_Private1	subnet-08bd6bf8b872d1fe5	Available	vpc-082e956a61b1be174 | Da...	10.0.3.0/24
NAT_Server_Public1	subnet-067671b979ac8a755	Available	vpc-082e956a61b1be174 | Da...	10.0.1.0/24
Dev_Server_Public2	subnet-07245c69f0f62a9cd	Available	vpc-082e956a61b1be174 | Da...	10.0.2.0/24

Figure 3: IPv4 CIDR for each subnet.

As it is still in development phase, the Dev_Server_Public2 Subnet will be routed to the Internet Gateway so as to test the website for its functionality. Later on, when the website is completed in terms of functionality, we will create an AMI for Deb_Server_Public2 and deploy it wherever necessary.

The two Private subnets will be used to deploy autoscaling group, therefore, they will be routed to the NAT. It is noteworthy that in this assignment, the NAT Gateway will be used instead of NAT instance.

Finally, the NAT_Server_Public1 will be the subnet to host the NAT Gateway, so it will be routed to the Internet Gateway. The following figure will further illustrate this:



nat-0869cb908f4af63e6 / DangViLuan_NAT

Details

NAT gateway ID
nat-0869cb908f4af63e6

NAT gateway ARN
arn:aws:ec2:us-east-1:315149204672:natgateway/nat-0869cb908f4af63e6

VPC
vpc-082e956a61b1be174 /

Connectivity type
Public

Primary public IPv4 address
52.44.48.83

Subnet
subnet-067671b979ac8a755 / NAT_Server_Public1

State
Available

Primary private IPv4 address
10.0.1.163

Created
Saturday, March 25, 2023 at 18:09:41 GMT+7

State message
–

Primary network interface ID
eni-03a2ed927ae56a7e0

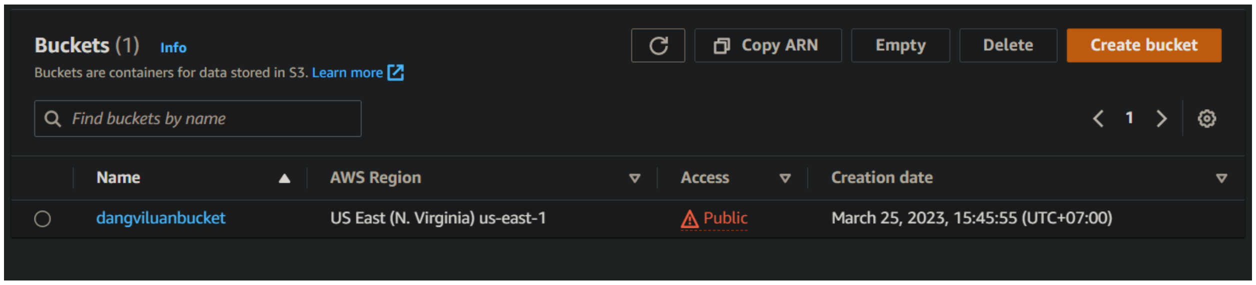
Deleted
–

Figure 4: NAT Gateway in NAT_Server_Public1

NAT will also conclude our first stage of this assignment, with the VPC fully constructed, we will move on to create entities that reside in these subnets.

III. Functionalities of the Website

As mentioned above, we will develop our website in public subnet 2 and only after making sure that every functionality is satisfied will we deploy it onto other subnets. Our first task would be to make sure that S3 bucket is working.

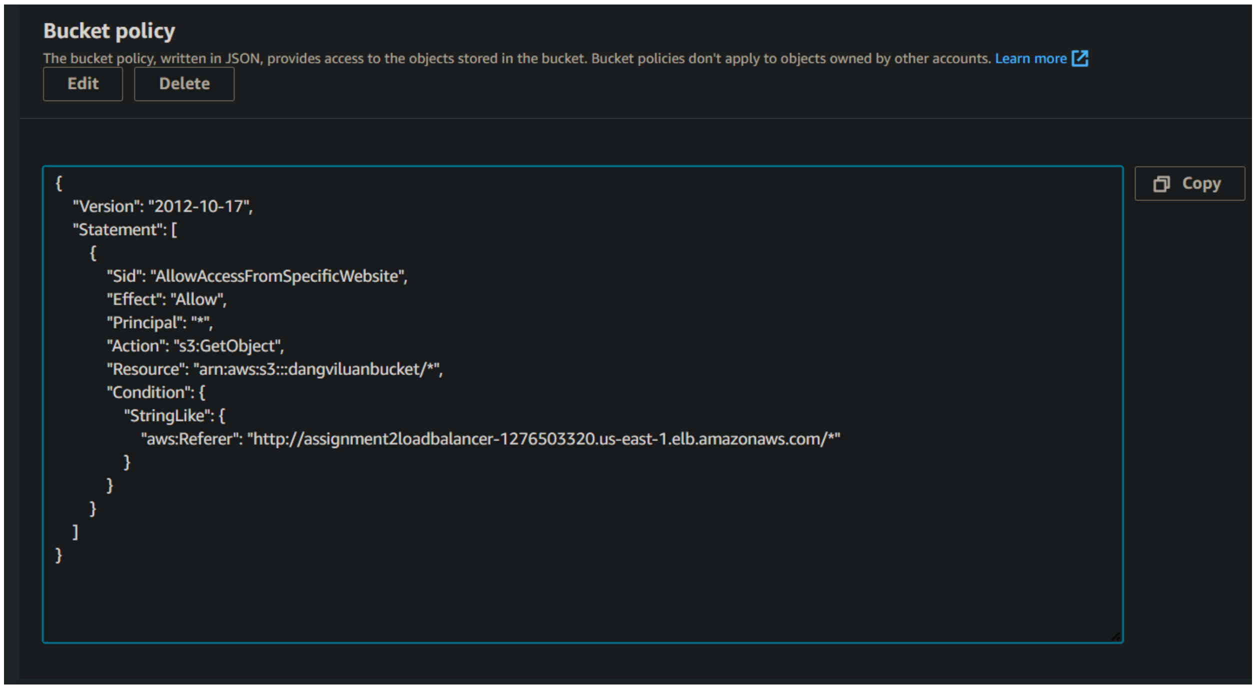


Buckets are containers for data stored in S3. Learn more

Name	AWS Region	Access	Creation date
dangviluanbucket	US East (N. Virginia) us-east-1	Public	March 25, 2023, 15:45:55 (UTC+07:00)

Figure 5: S3 Bucket for Assignment 2.

According to the architecture diagram our S3 bucket will only allow access from and by the Application Load Balancer (ALB), therefore, a bucket policy will be provided so as to restrict permission from and to our bucket.

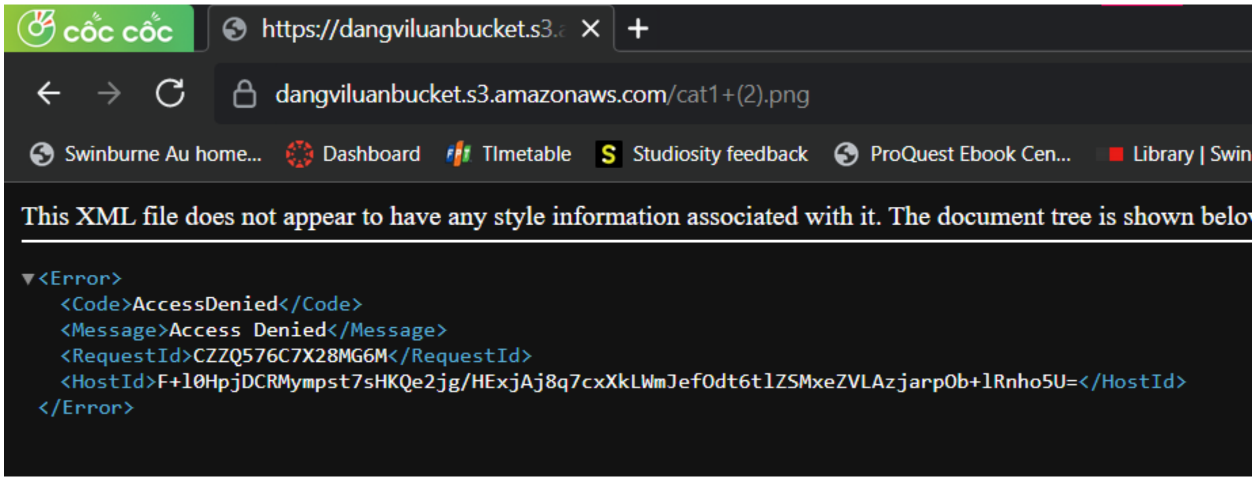


The bucket policy, written in JSON, provides access to the objects stored in the bucket. Bucket policies don't apply to objects owned by other accounts. Learn more

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowAccessFromSpecificWebsite",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "s3:GetObject",
      "Resource": "arn:aws:s3:::dangviluanbucket/*",
      "Condition": {
        "StringLike": {
          "aws:Referer": "http://assignment2loadbalancer-1276503320.us-east-1.elb.amazonaws.com/*"
        }
      }
    }
  ]
}
```

Figure 6: S3 Bucket Policy.

With the policy in its place, unauthorized access to our objects will not be possible.

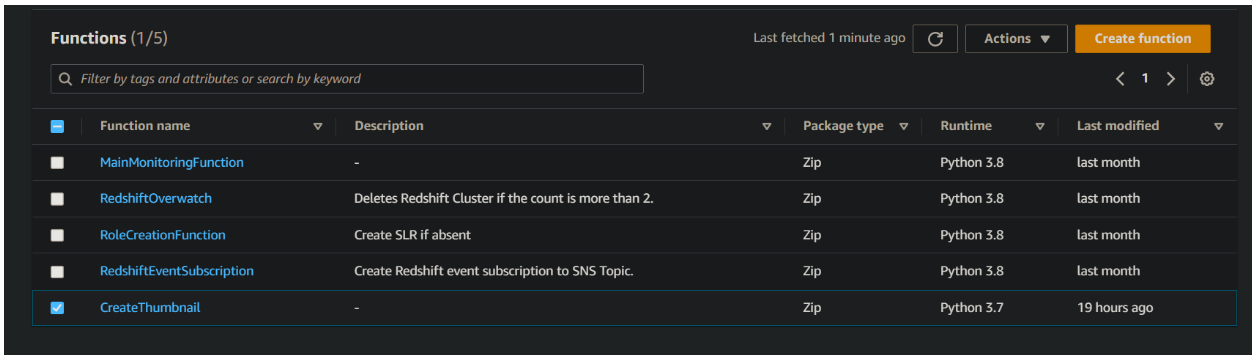


This XML file does not appear to have any style information associated with it. The document tree is shown belo

```
▼<Error>
   <Code>AccessDenied</Code>
   <Message>Access Denied</Message>
   <RequestId>CZZQ576C7X28MG6M</RequestId>
   <HostId>F+l0HpjDCRMympst7sHKQe2jg/HExjAj8q7cxXkLWmJefOdt6tlZSMxeZVLAzjarpOb+lRnho5U=</HostId>
 </Error>
```

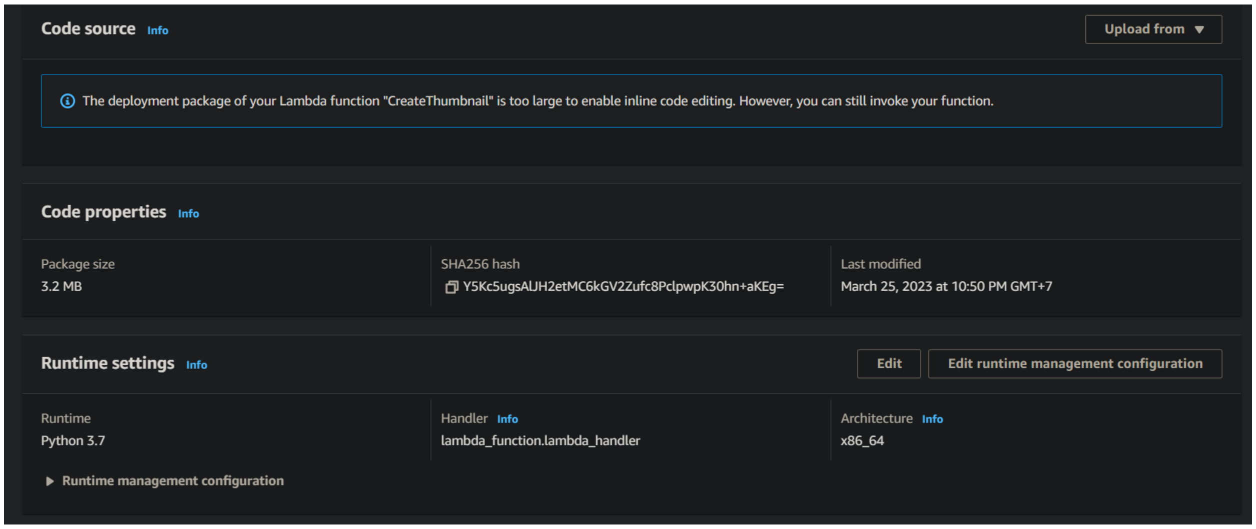
Figure 7: Unauthorized access to the S3 Objects.

A Lambda function will also be needed to resize uploaded picture to S3.


Functions (1/5)
Last fetched 1 minute ago
Actions
Create function
Filter by tags and attributes or search by keyword
1

Function name	Description	Package type	Runtime	Last modified
MainMonitoringFunction	-	Zip	Python 3.8	last month
RedshiftOverwatch	Deletes Redshift Cluster if the count is more than 2.	Zip	Python 3.8	last month
RoleCreationFunction	Create SLR if absent	Zip	Python 3.8	last month
RedshiftEventSubscription	Create Redshift event subscription to SNS Topic.	Zip	Python 3.8	last month
CreateThumbnail	-	Zip	Python 3.7	19 hours ago

Figure 8: Lambda function for creating thumbnail.



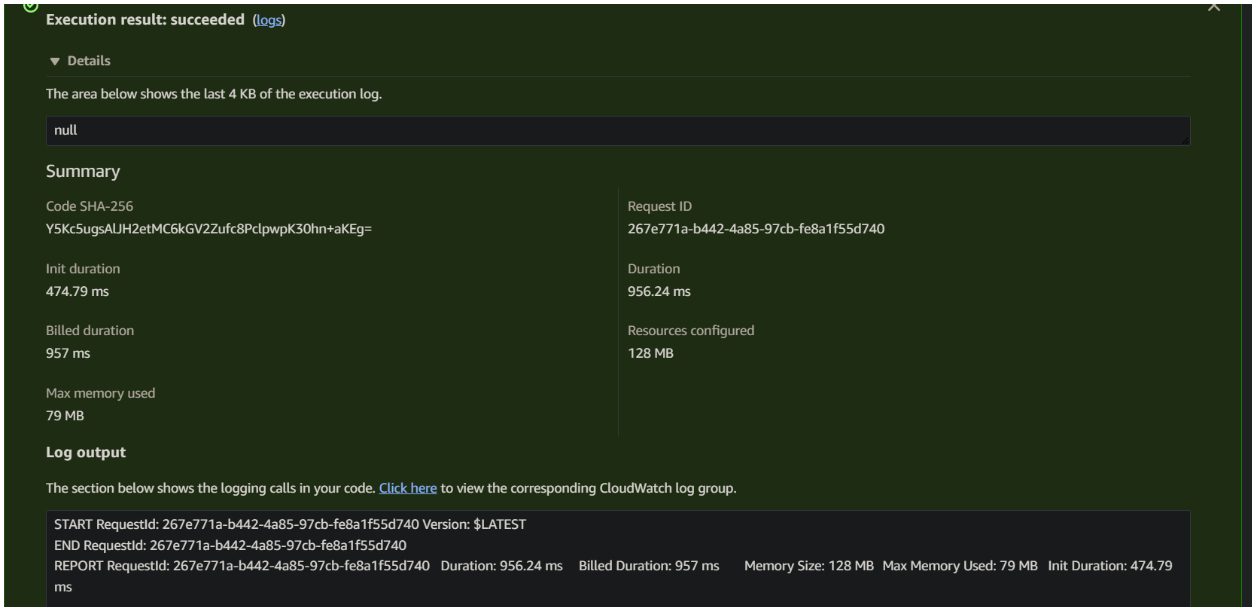
The deployment package of your Lambda function "CreateThumbnail" is too large to enable inline code editing. However, you can still invoke your function.

Package size	SHA256 hash	Last modified
3.2 MB	Y5Kc5ugsAUH2etMC6kGV2Zufc8PclpwpK30hn+aKEg=	March 25, 2023 at 10:50 PM GMT+7

Runtime	Handler	Architecture
Python 3.7	lambda_function.lambda_handler	x86_64

Figure 9: Code structure and properties of the Lambda function.

As the package for creating the function is provided, we only need to test the package to make sure nothing goes wrong.


Execution result: succeeded (logs)

Details

The area below shows the last 4 KB of the execution log.

```
null
```

Summary

Code SHA-256	Y5Kc5ugsAlJH2etMC6kGV2Zufc8PclpwpK30hn+aKEg=
Request ID	267e771a-b442-4a85-97cb-fe8a1f55d740
Init duration	474.79 ms
Duration	956.24 ms
Billed duration	957 ms
Resources configured	128 MB
Max memory used	79 MB

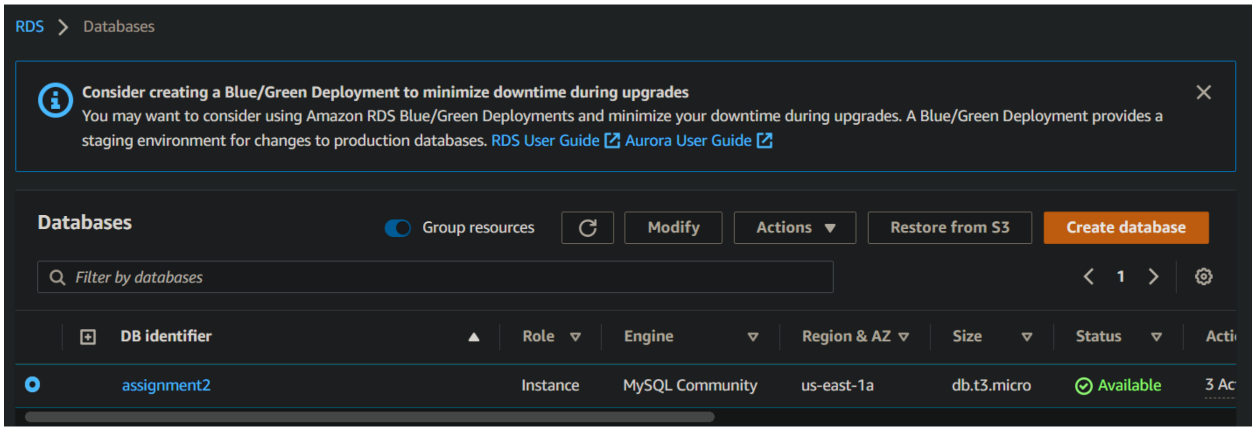
Log output

The section below shows the logging calls in your code. Click here to view the corresponding CloudWatch log group.

```
START RequestId: 267e771a-b442-4a85-97cb-fe8a1f55d740 Version: $LATEST
END RequestId: 267e771a-b442-4a85-97cb-fe8a1f55d740
REPORT RequestId: 267e771a-b442-4a85-97cb-fe8a1f55d740  Duration: 956.24 ms   Billed Duration: 957 ms    Memory Size: 128 MB  Max Memory Used: 79 MB  Init Duration: 474.79
ms
```

Figure 10: Lambda function test case.

With the test case successfully executed we will move onto the next part which is to create Relational Database Service (RDS), with RDS we can launch a database instance in minutes.



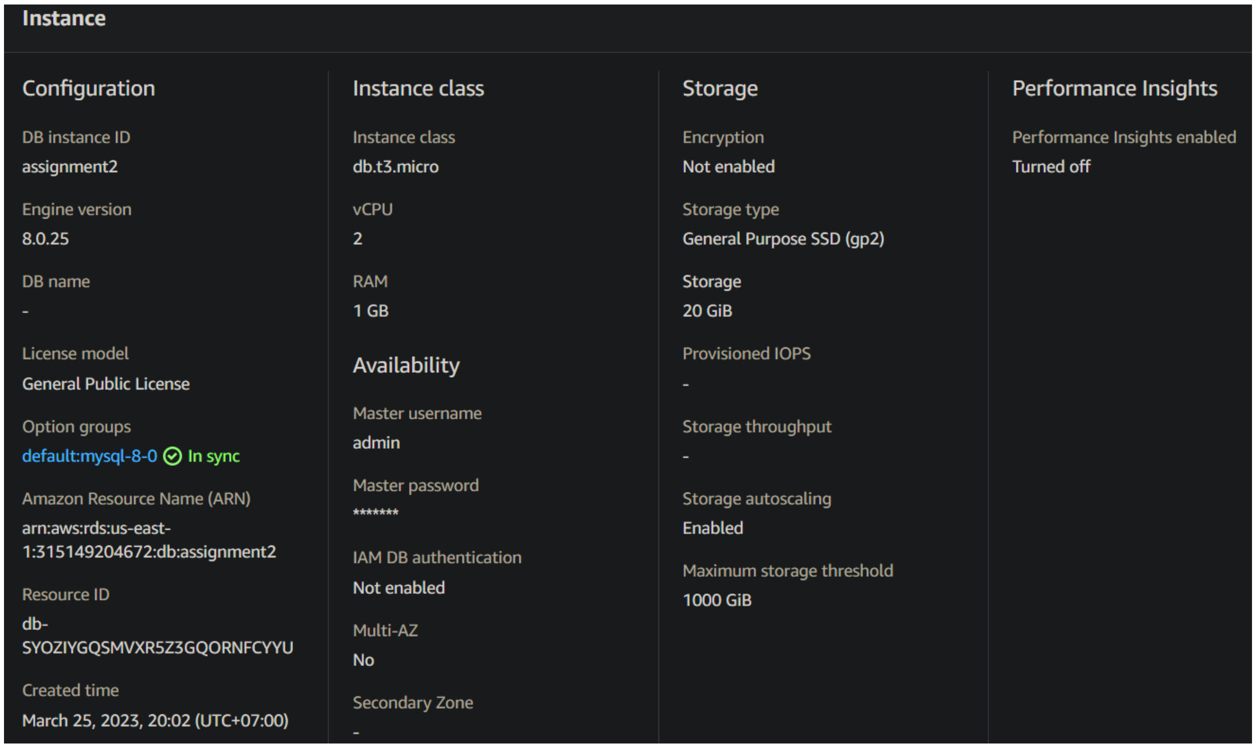
Consider creating a Blue/Green Deployment to minimize downtime during upgrades

You may want to consider using Amazon RDS Blue/Green Deployments and minimize your downtime during upgrades. A Blue/Green Deployment provides a staging environment for changes to production databases. RDS User Guide Aurora User Guide

DB identifier	Role	Engine	Region & AZ	Size	Status	Acti
assignment2	Instance	MySQL Community	us-east-1a	db.t3.micro	Available	3 Ac

Figure 11: RDS successfully deployed.

Detailed configuration of the RDS are as follows:



Instance

Configuration

DB instance ID
assignment2

Engine version
8.0.25

DB name
-

License model
General Public License

Option groups
default:mysql-8-0 In sync

Amazon Resource Name (ARN)
arn:aws:rds:us-east-1:315149204672:db:assignment2

Resource ID
db-SYOZIYGQSMVXR5Z3GQORNFCYYU

Created time
March 25, 2023, 20:02 (UTC+07:00)

Instance class

Instance class
db.t3.micro

vCPU
2

RAM
1 GB

Availability

Master username
admin

Master password
****

IAM DB authentication
Not enabled

Multi-AZ
No

Secondary Zone
-

Storage

Encryption
Not enabled

Storage type
General Purpose SSD (gp2)

Storage
20 GiB

Provisioned IOPS
-

Storage throughput
-

Storage autoscaling
Enabled

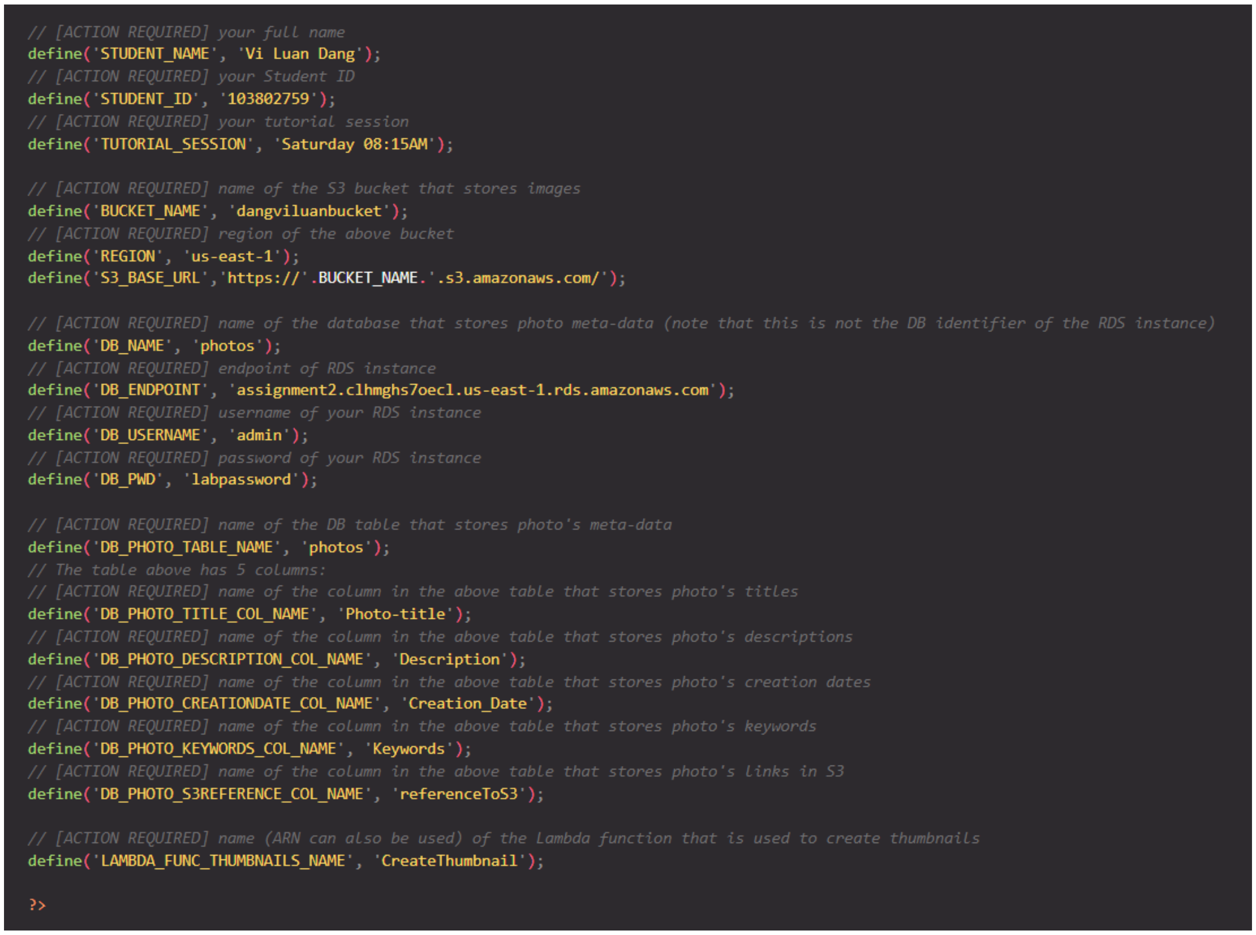
Maximum storage threshold
1000 GiB

Performance Insights

Performance Insights enabled
Turned off

Figure 12: RDS detailed configuration.

Before we can put our website onto the development server, we will need to configure all the missing part of the provided code for the website. To be specific, we will need to modify the *constant.php* in the provided ZIP file.



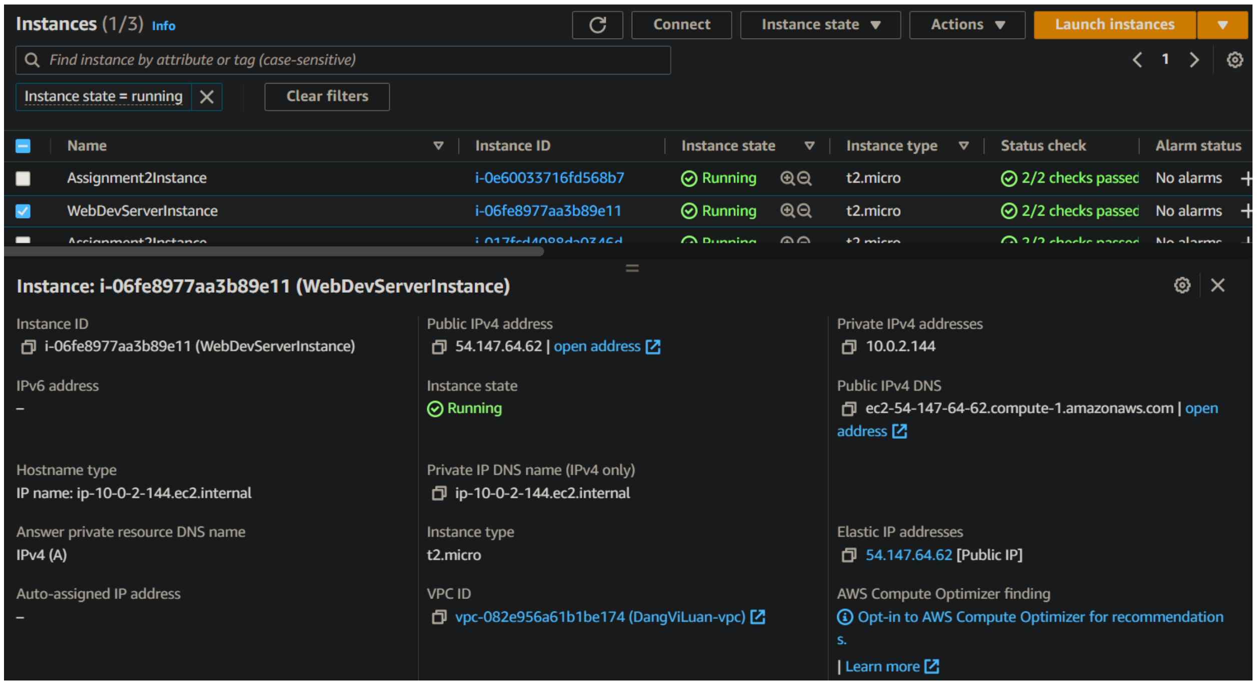
```php
// [ACTION REQUIRED] your full name
define('STUDENT_NAME', 'Vi Luan Dang');
// [ACTION REQUIRED] your Student ID
define('STUDENT_ID', '103802759');
// [ACTION REQUIRED] your tutorial session
define('TUTORIAL_SESSION', 'Saturday 08:15AM');

// [ACTION REQUIRED] name of the S3 bucket that stores images
define('BUCKET_NAME', 'dangviluanbucket');
// [ACTION REQUIRED] region of the above bucket
define('REGION', 'us-east-1');
define('S3_BASE_URL','https://'.BUCKET_NAME.'.s3.amazonaws.com/');

// [ACTION REQUIRED] name of the database that stores photo meta-data (note that this is not the DB identifier of the RDS instance)
define('DB_NAME', 'photos');
// [ACTION REQUIRED] endpoint of RDS instance
define('DB_ENDPOINT', 'assignment2.clhmghs7oecl.us-east-1.rds.amazonaws.com');
// [ACTION REQUIRED] username of your RDS instance
define('DB_USERNAME', 'admin');
// [ACTION REQUIRED] password of your RDS instance
define('DB_PWD', 'labpassword');

// [ACTION REQUIRED] name of the DB table that stores photo's meta-data
define('DB_PHOTO_TABLE_NAME', 'photos');
// The table above has 5 columns:
// [ACTION REQUIRED] name of the column in the above table that stores photo's titles
define('DB_PHOTO_TITLE_COL_NAME', 'Photo-title');
// [ACTION REQUIRED] name of the column in the above table that stores photo's descriptions
define('DB_PHOTO_DESCRIPTION_COL_NAME', 'Description');
// [ACTION REQUIRED] name of the column in the above table that stores photo's creation dates
define('DB_PHOTO_CREATIONDATE_COL_NAME', 'Creation_Date');
// [ACTION REQUIRED] name of the column in the above table that stores photo's keywords
define('DB_PHOTO_KEYWORDS_COL_NAME', 'Keywords');
// [ACTION REQUIRED] name of the column in the above table that stores photo's links in S3
define('DB_PHOTO_S3REFERENCE_COL_NAME', 'referenceToS3');

// [ACTION REQUIRED] name (ARN can also be used) of the Lambda function that is used to create thumbnails
define('LAMBDA_FUNC_THUMBNAILS_NAME', 'CreateThumbnail');

?>
```

Figure 13: Modified constant.php

With all the components successfully configured, we can then move to creating an EC2 instance on the development server.

IV. Development of the Website using EC2 and AMI

All the functionalities of our website will require a host to work, an EC2 instance would be an ideal environment for our website.



Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Assignment2Instance	i-0e60033716fd568b7	Running	t2.micro	2/2 checks passed	No alarms
WebDevServerInstance	i-06fe8977aa3b89e11	Running	t2.micro	2/2 checks passed	No alarms

Instance: i-06fe8977aa3b89e11 (WebDevServerInstance)

Instance ID
i-06fe8977aa3b89e11 (WebDevServerInstance)

Public IPv4 address
54.147.64.62 | open address

Private IPv4 addresses
10.0.2.144

IPv6 address
–

Instance state
Running

Public IPv4 DNS
ec2-54-147-64-62.compute-1.amazonaws.com | open address

Hostname type
IP name: ip-10-0-2-144.ec2.internal

Private IP DNS name (IPv4 only)
ip-10-0-2-144.ec2.internal

Answer private resource DNS name
IPv4 (A)

Instance type
t2.micro

Elastic IP addresses
54.147.64.62 [Public IP]

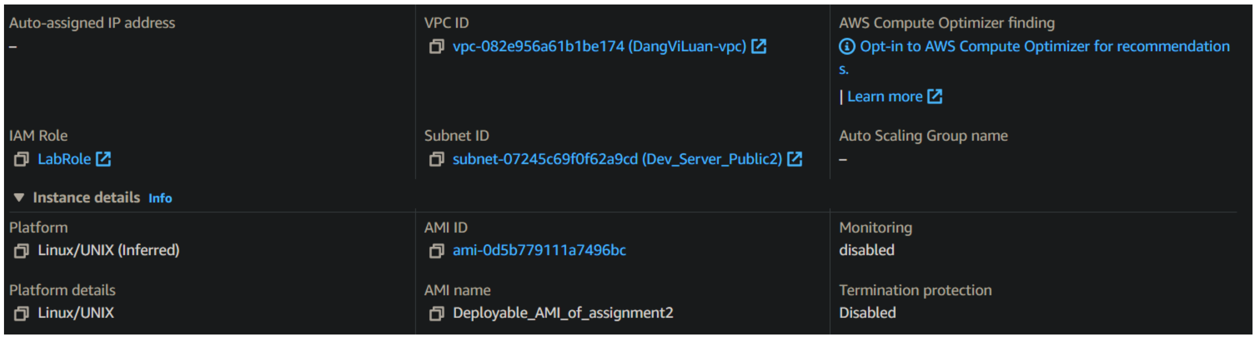
Auto-assigned IP address
–

VPC ID
vpc-082e956a61b1be174 (DangViLuan-vpc)

AWS Compute Optimizer finding
Opt-in to AWS Compute Optimizer for recommendations.
| Learn more

Figure 14: WebDevServerInstance.

An IAM role would also be necessary to be able to put objects into the S3 bucket and invoke the CreateThumbnail Lambda function.



Auto-assigned IP address
–

VPC ID
vpc-082e956a61b1be174 (DangViLuan-vpc)

AWS Compute Optimizer finding
Opt-in to AWS Compute Optimizer for recommendations.
| Learn more

IAM Role
LabRole

Subnet ID
subnet-07245c69f0f62a9cd (Dev_Server_Public2)

Auto Scaling Group name
–

Instance details Info

Platform
Linux/UNIX (Inferred)

AMI ID
ami-0d5b779111a7496bc

Monitoring
disabled

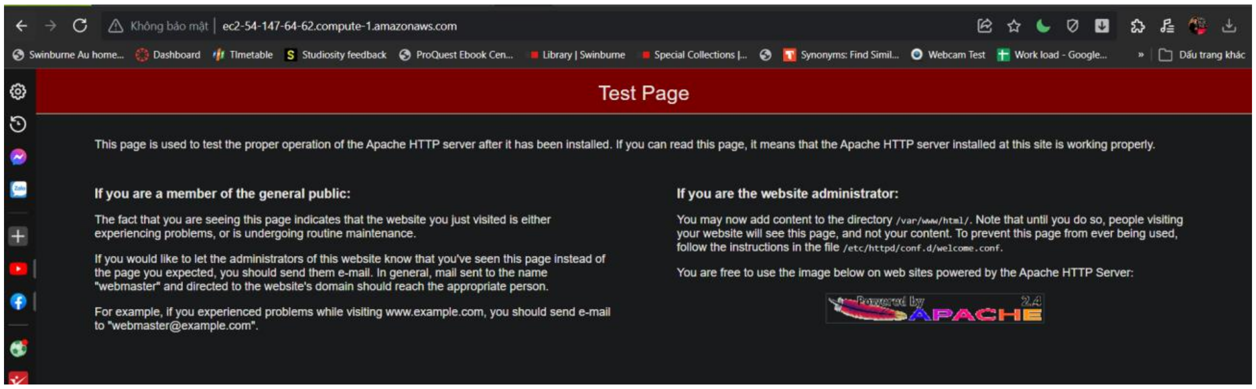
Platform details
Linux/UNIX

AMI name
Deployable_AMI_of_assignment2

Termination protection
Disabled

Figure 15: Further configuration of WebDevServerInstance.

After deploying the EC2 instance, we can check if it is accessible by allocating for it an Elastic Ips and access the website via its public IPv4 DNS:


Không bảo mật | ec2-54-147-64-62.compute-1.amazonaws.com
Swinburne Au home... Dashboard Timetable Studiosity feedback ProQuest Ebook Cen... Library | Swinburne Special Collections |... Synonyms: Find Simil... Webcam Test Work load - Google... Dấu trang khác

Test Page

This page is used to test the proper operation of the Apache HTTP server after it has been installed. If you can read this page, it means that the Apache HTTP server installed at this site is working properly.

If you are a member of the general public:

The fact that you are seeing this page indicates that the website you just visited is either experiencing problems, or is undergoing routine maintenance.

If you would like to let the administrators of this website know that you've seen this page instead of the page you expected, you should send them e-mail. In general, mail sent to the name "webmaster" and directed to the website's domain should reach the appropriate person.

For example, if you experienced problems while visiting www.example.com, you should send e-mail to "webmaster@example.com".

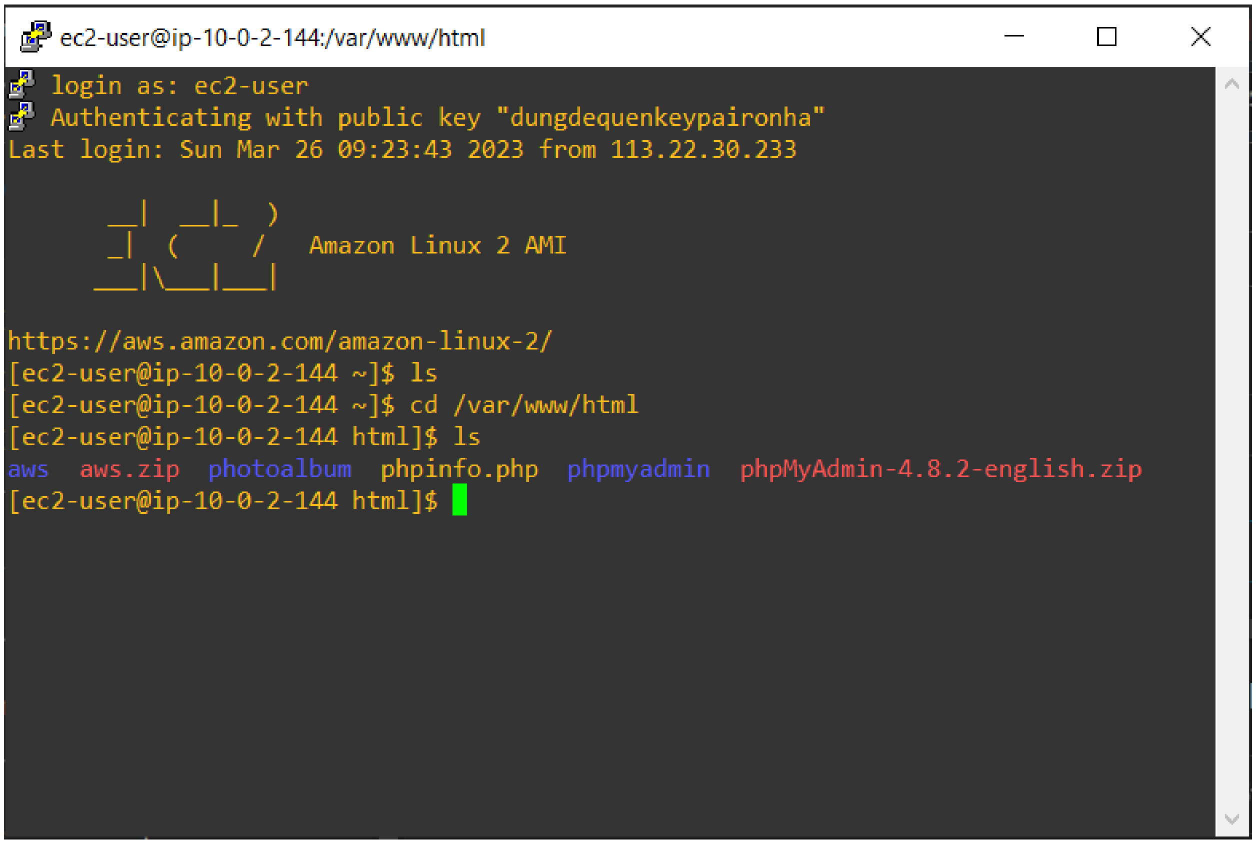
If you are the website administrator:

You may now add content to the directory `/var/www/html/`. Note that until you do so, people visiting your website will see this page, and not your content. To prevent this page from ever being used, follow the instructions in the file `/etc/httpd/conf.d/welcome.conf`.

You are free to use the image below on web sites powered by the Apache HTTP Server:

Figure 16: EC2 Instance successfully deployed.

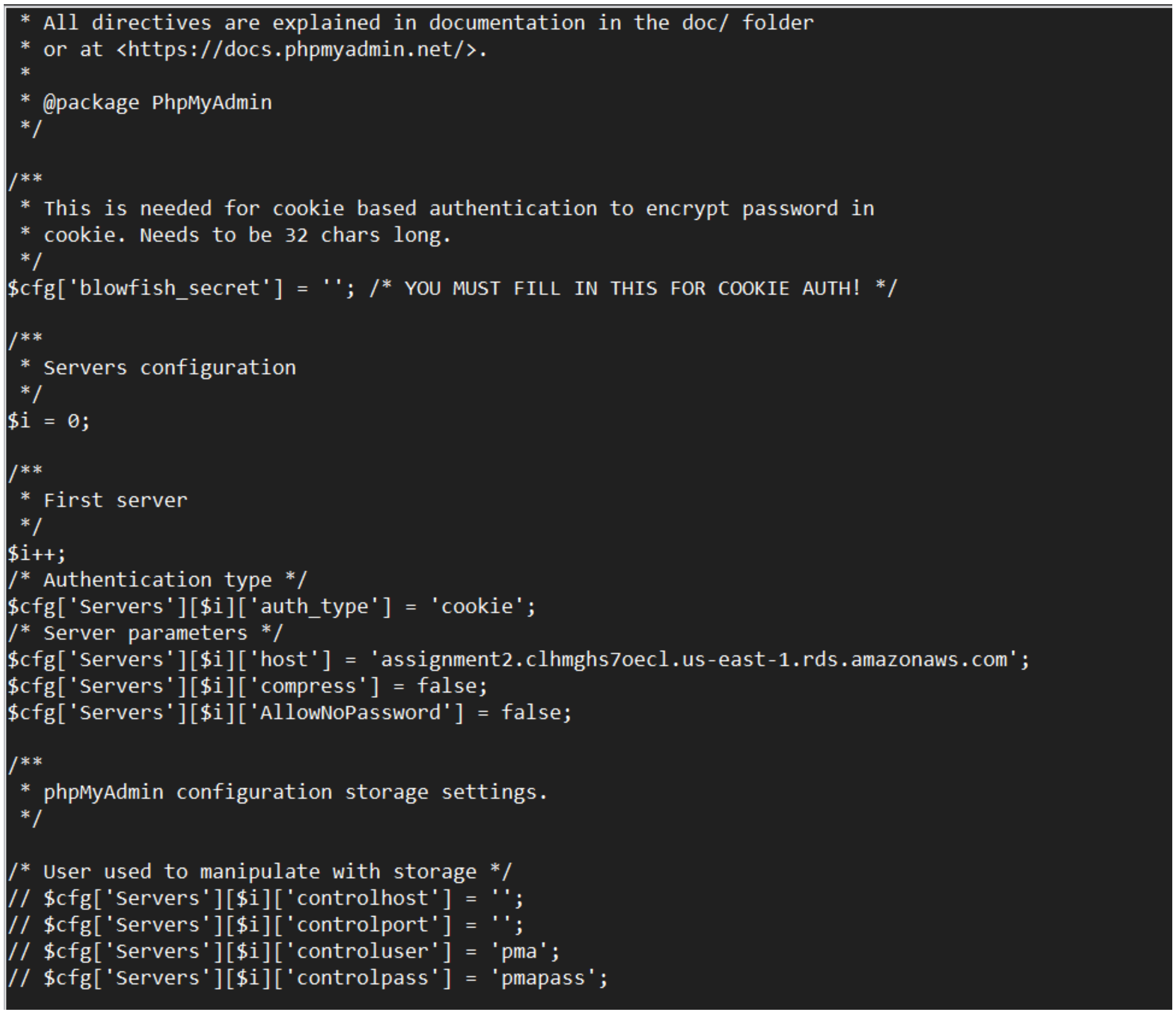
We will then connect to the instance via SSH to configure the database using the same Public IPv4 DNS.



```
login as: ec2-user
Authenticating with public key "dungdequenkeypaironha"
Last login: Sun Mar 26 09:23:43 2023 from 113.22.30.233

       __|  __|_  )
       _|  (     /   Amazon Linux 2 AMI
      ___|\___|___|

https://aws.amazon.com/amazon-linux-2/
[ec2-user@ip-10-0-2-144 ~]$ ls
[ec2-user@ip-10-0-2-144 ~]$ cd /var/www/html
[ec2-user@ip-10-0-2-144 html]$ ls
aws  aws.zip  photoalbum  phpinfo.php  phpmyadmin  phpMyAdmin-4.8.2-english.zip
[ec2-user@ip-10-0-2-144 html]$
```

Figure 17: WebDevServer SSH terminal.

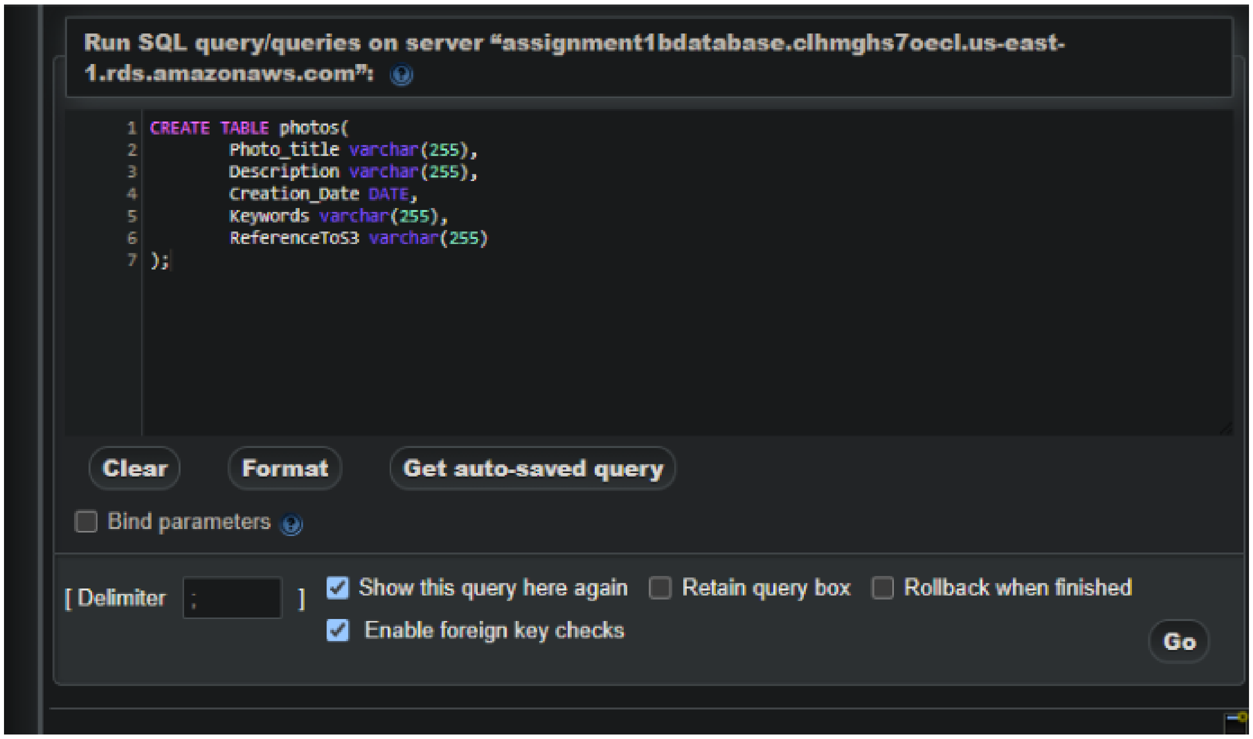
Phpmyadmin is required to create meta-data for our database as well as monitor its overall operation. A small adjustment in *config.inc.php* is required so as to connect our *phpMyAdmin* console with the RDS instance created in stage 3.



```
 * All directives are explained in documentation in the doc/ folder
 * or at <https://docs.phpmyadmin.net/>.
 *
 * @package PhpMyAdmin
 */

/**
 * This is needed for cookie based authentication to encrypt password in
 * cookie. Needs to be 32 chars long.
 */
$cfg['blowfish_secret'] = ''; /* YOU MUST FILL IN THIS FOR COOKIE AUTH! */

/**
 * Servers configuration
 */
$i = 0;

/**
 * First server
 */
$i++;
/* Authentication type */
$cfg['Servers'][$i]['auth_type'] = 'cookie';
/* Server parameters */
$cfg['Servers'][$i]['host'] = 'assignment2.clhmghs7oecl.us-east-1.rds.amazonaws.com';
$cfg['Servers'][$i]['compress'] = false;
$cfg['Servers'][$i]['AllowNoPassword'] = false;

/**
 * phpMyAdmin configuration storage settings.
 */

/* User used to manipulate with storage */
// $cfg['Servers'][$i]['controlhost'] = '';
// $cfg['Servers'][$i]['controlport'] = '';
// $cfg['Servers'][$i]['controluser'] = 'pma';
// $cfg['Servers'][$i]['controlpass'] = 'pmapass';
```

Figure 18: config.inc.php

After changing the value of '*localhost'* in *config.inc.php* we can access *phpMyAdmin* on our developing server website to create meta-data for our database.



Run SQL query/queries on server "assignment1bdatabase.clhmghs7oecl.us-east-1.rds.amazonaws.com":

```sql
CREATE TABLE photos(
        Photo_title varchar(255),
        Description varchar(255),
        Creation_Date DATE,
        Keywords varchar(255),
        ReferenceToS3 varchar(255)
);
```

[Delimiter ;]

[✓] Show this query here again
[ ] Retain query box
[ ] Rollback when finished
[✓] Enable foreign key checks

Figure 19: Meta-data for the database

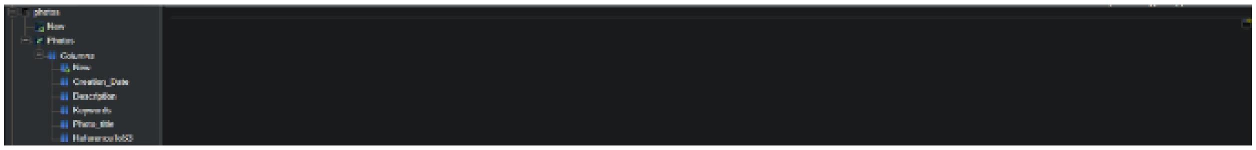
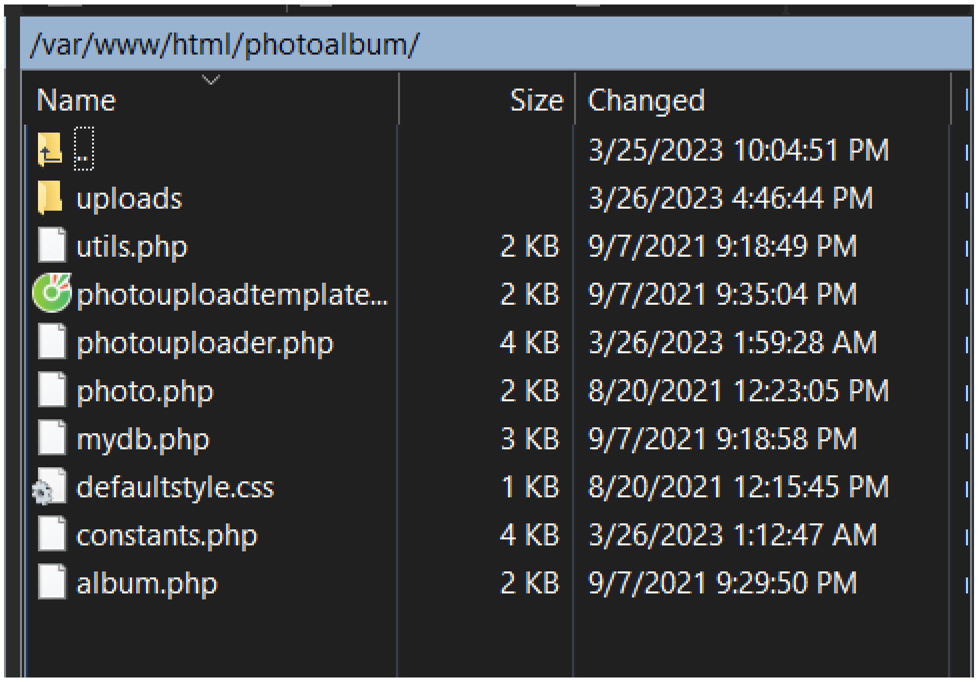


Figure 20: Table photos

We can then upload the provided codes to test our website.

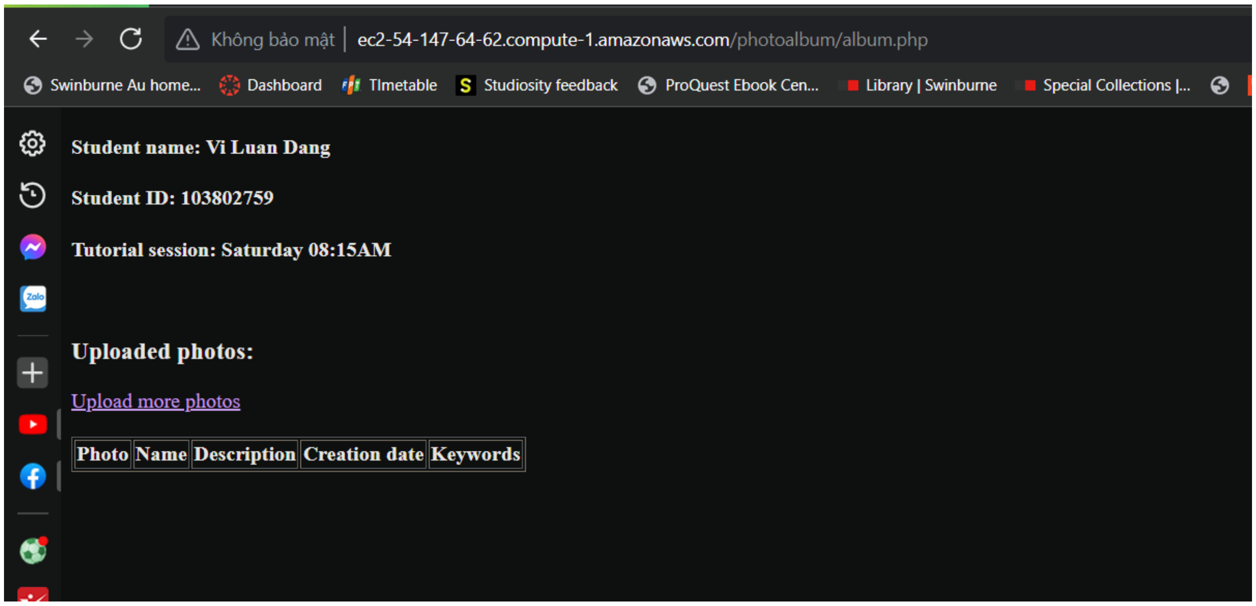


/var/www/html/photoalbum/

Name	Size	Changed
..		3/25/2023 10:04:51 PM
uploads		3/26/2023 4:46:44 PM
utils.php	2 KB	9/7/2021 9:18:49 PM
photouploadtemplate...	2 KB	9/7/2021 9:35:04 PM
photouploader.php	4 KB	3/26/2023 1:59:28 AM
photo.php	2 KB	8/20/2021 12:23:05 PM
mydb.php	3 KB	9/7/2021 9:18:58 PM
defaultstyle.css	1 KB	8/20/2021 12:15:45 PM
constants.php	4 KB	3/26/2023 1:12:47 AM
album.php	2 KB	9/7/2021 9:29:50 PM

Figure 21: Uploaded codes for the website

Our *album.php* site on the developing server website would look like this:


Không bảo mật | ec2-54-147-64-62.compute-1.amazonaws.com/photoalbum/album.php

Swinburne Au home... Dashboard Timetable Studiosity feedback ProQuest Ebook Cen... Library | Swinburne Special Collections |...

Student name: Vi Luan Dang

Student ID: 103802759

Tutorial session: Saturday 08:15AM

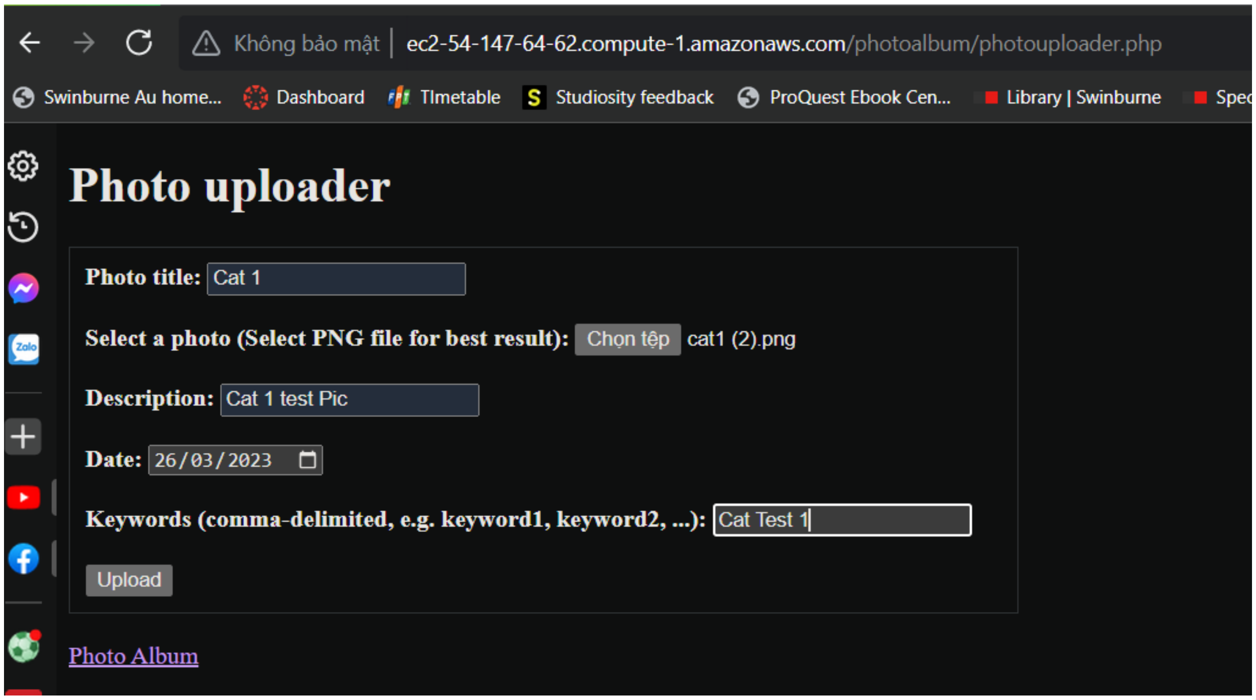
Uploaded photos:

Upload more photos

Photo	Name	Description	Creation date	Keywords

Figure 22: album.php

We can proceed to upload some photos on the website.


Không bảo mật | ec2-54-147-64-62.compute-1.amazonaws.com/photoalbum/photouploader.php

Swinburne Au home... Dashboard Timetable Studiosity feedback ProQuest Ebook Cen... Library | Swinburne Spec

Photo uploader

Photo title: Cat 1

Select a photo (Select PNG file for best result): Chọn tệp cat1 (2).png

Description: Cat 1 test Pic

Date: 26/03/2023

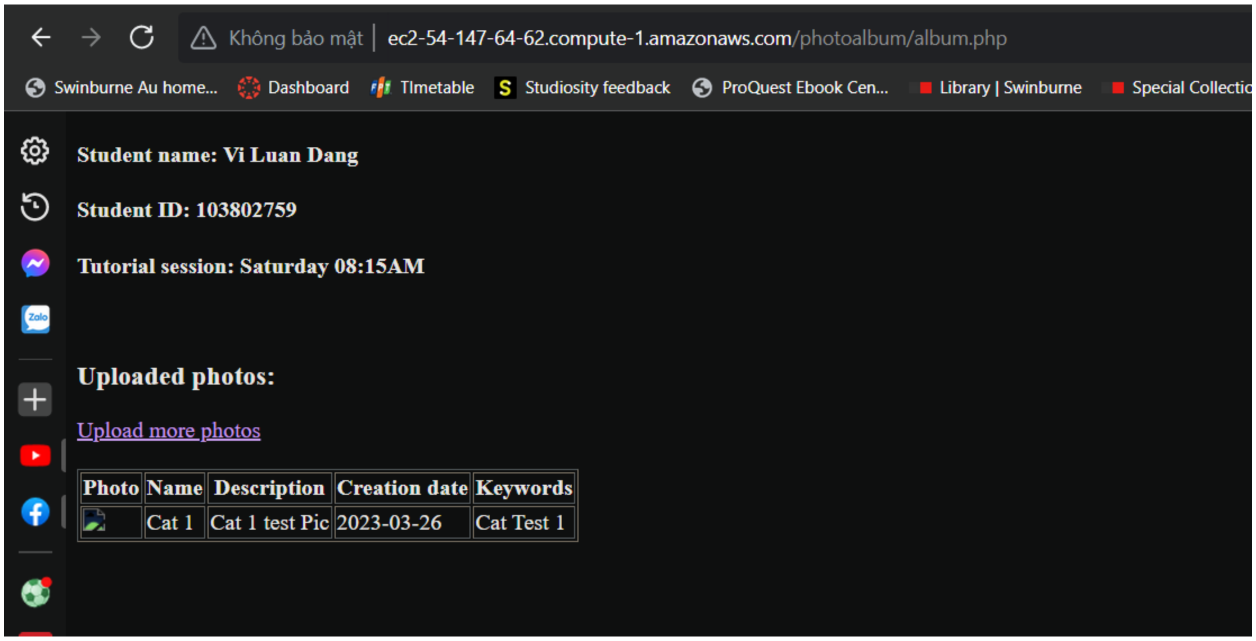
Keywords (comma-delimited, e.g. keyword1, keyword2, ...): Cat Test 1

Upload

Photo Album

Figure 23: photouploader.php

After uploading we can observe the photo in both phpMyAdmin to view meta-data, and S3 to view the resized picture. However, as we will restrict *album.php* so that it only show the pictures whenever we access from our Load Balancer, there will not be any picture in *album.php* when viewing from the developing server. This will, however, change when we deploy our Web server from Auto Scaling Group.


Không bảo mật | ec2-54-147-64-62.compute-1.amazonaws.com/photoalbum/album.php

Swinburne Au home... Dashboard TImetable Studiosity feedback ProQuest Ebook Cen... Library | Swinburne Special Collectio

Student name: Vi Luan Dang

Student ID: 103802759

Tutorial session: Saturday 08:15AM

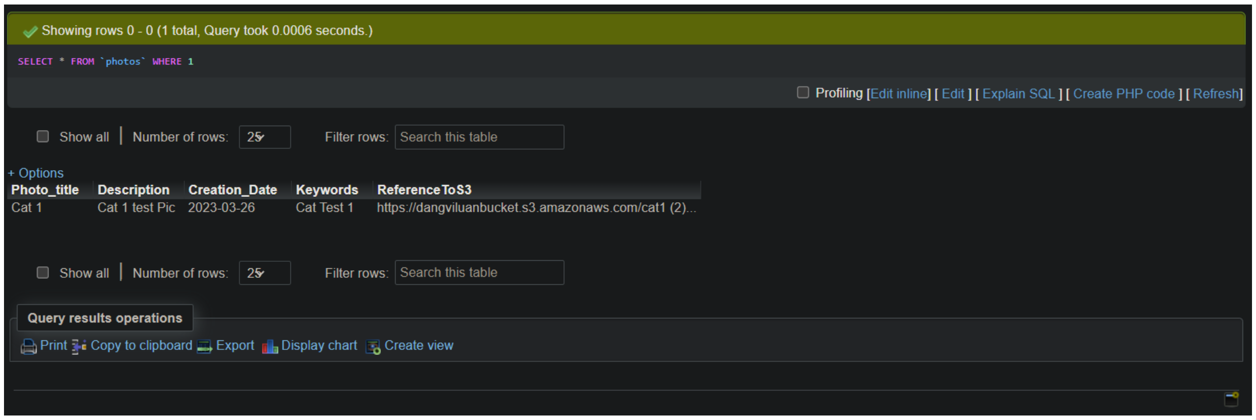
Uploaded photos:

Upload more photos

Photo	Name	Description	Creation date	Keywords
	Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1

Figure 24: album.php from the developing server

In the meantime, however, we can see that S3 and the meta data in phpMyAdmin works as expected.


Showing rows 0 - 0 (1 total, Query took 0.0006 seconds.)

```
SELECT * FROM `photos` WHERE 1
```

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 Filter rows: Search this table

+ Options

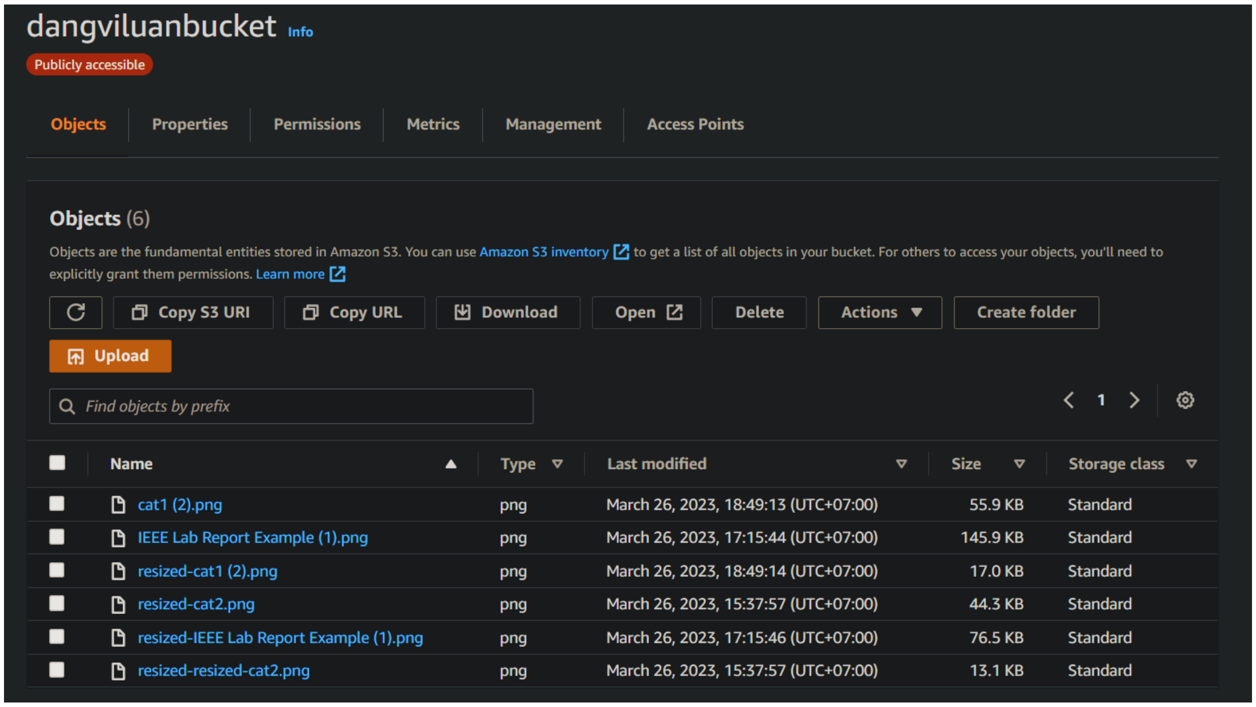
Photo_title	Description	Creation_Date	Keywords	ReferenceToS3
Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1	https://dangviluanbucket.s3.amazonaws.com/cat1 (2)...

Show all | Number of rows: 25 Filter rows: Search this table

Query results operations

Print Copy to clipboard Export Display chart Create view

Figure 25: Meta-data in phpmyadmin


dangviluanbucket Info

Publicly accessible

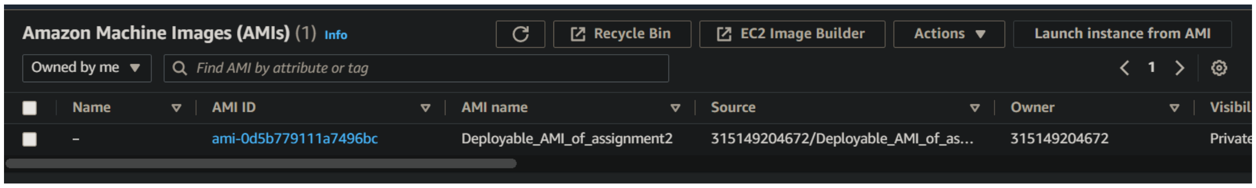
Objects (6)

Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

Name	Type	Last modified	Size	Storage class
cat1 (2).png	png	March 26, 2023, 18:49:13 (UTC+07:00)	55.9 KB	Standard
IEEE Lab Report Example (1).png	png	March 26, 2023, 17:15:44 (UTC+07:00)	145.9 KB	Standard
resized-cat1 (2).png	png	March 26, 2023, 18:49:14 (UTC+07:00)	17.0 KB	Standard
resized-cat2.png	png	March 26, 2023, 15:37:57 (UTC+07:00)	44.3 KB	Standard
resized-IEEE Lab Report Example (1).png	png	March 26, 2023, 17:15:46 (UTC+07:00)	76.5 KB	Standard
resized-resized-cat2.png	png	March 26, 2023, 15:37:57 (UTC+07:00)	13.1 KB	Standard

Figure 26: Cat1 and resized-cat1 objects in S3 Bucket.

This means that the functionality of our website is successfully configured and perfectly worked. We will move on to create an AMI of this WebDevServer and deploy it in our Auto Scaling Group.


Amazon Machine Images (AMIs) (1) Info

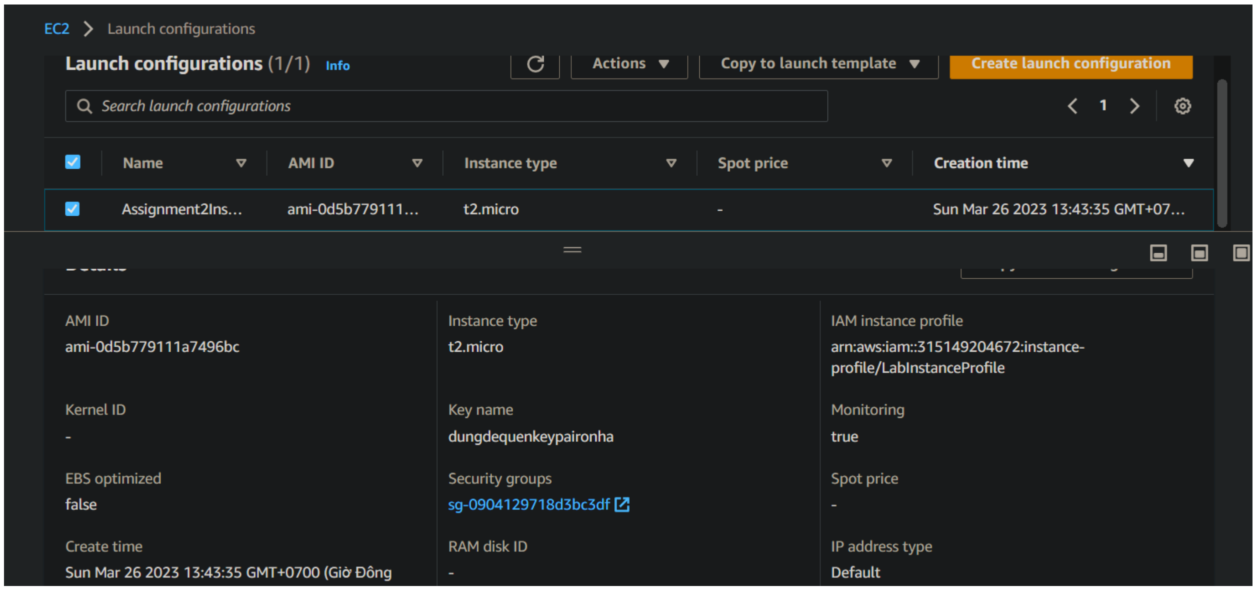
Name	AMI ID	AMI name	Source	Owner	Visibil
–	ami-0d5b779111a7496bc	Deployable_AMI_of_assignment2	315149204672/Deployable_AMI_of_as...	315149204672	Private

Figure 27: AMI of our WebDevServer.

V. Elastic Load Balancer and Auto Scaling Group

With the developing process finished, we can then focus on equipping our website with high availability and scalability using Elastic Load Balancer and Auto Scaling Group.

Firstly, we will need to create a Launch Configuration


EC2 > Launch configurations

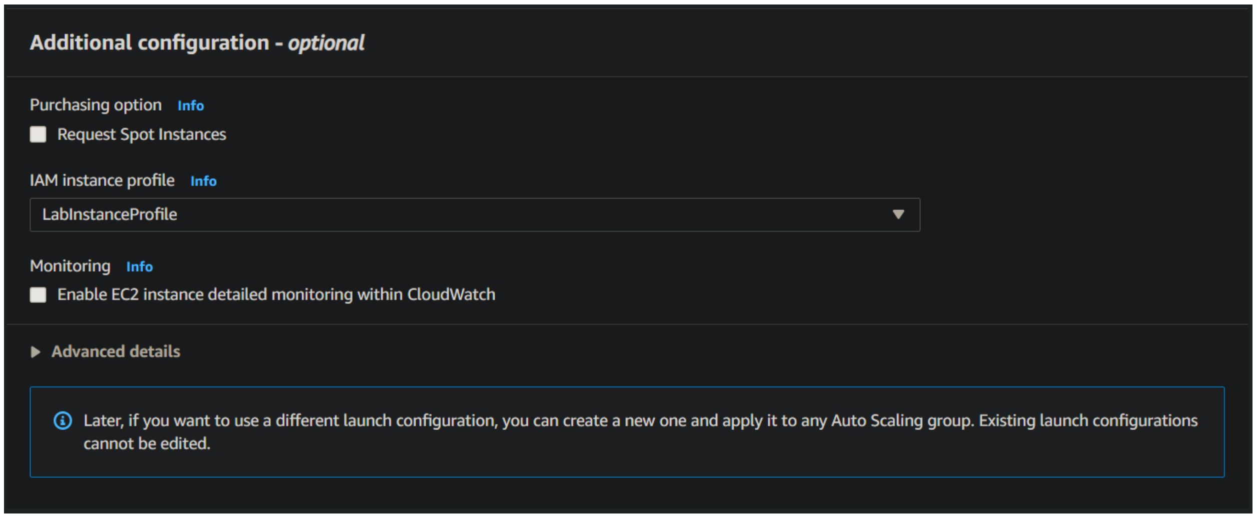
Launch configurations (1/1) Info

Name	AMI ID	Instance type	Spot price	Creation time
Assignment2Ins...	ami-0d5b779111...	t2.micro	-	Sun Mar 26 2023 13:43:35 GMT+07...

AMI ID: ami-0d5b779111a7496bc	Instance type: t2.micro	IAM instance profile: arn:aws:iam::315149204672:instance-profile/LabInstanceProfile
Kernel ID: -	Key name: dungdequenkeypaironha	Monitoring: true
EBS optimized: false	Security groups: sg-0904129718d3bc3df	Spot price: -
Create time: Sun Mar 26 2023 13:43:35 GMT+0700 (Giờ Đông	RAM disk ID: -	IP address type: Default

Figure 28: Launch Configuration

Apart from the configuration shown in the picture above, we need to ensure that the IAM is applied correctly using the provided profile.


Additional configuration - *optional*

Purchasing option Info
- [ ] Request Spot Instances

IAM instance profile Info: LabInstanceProfile

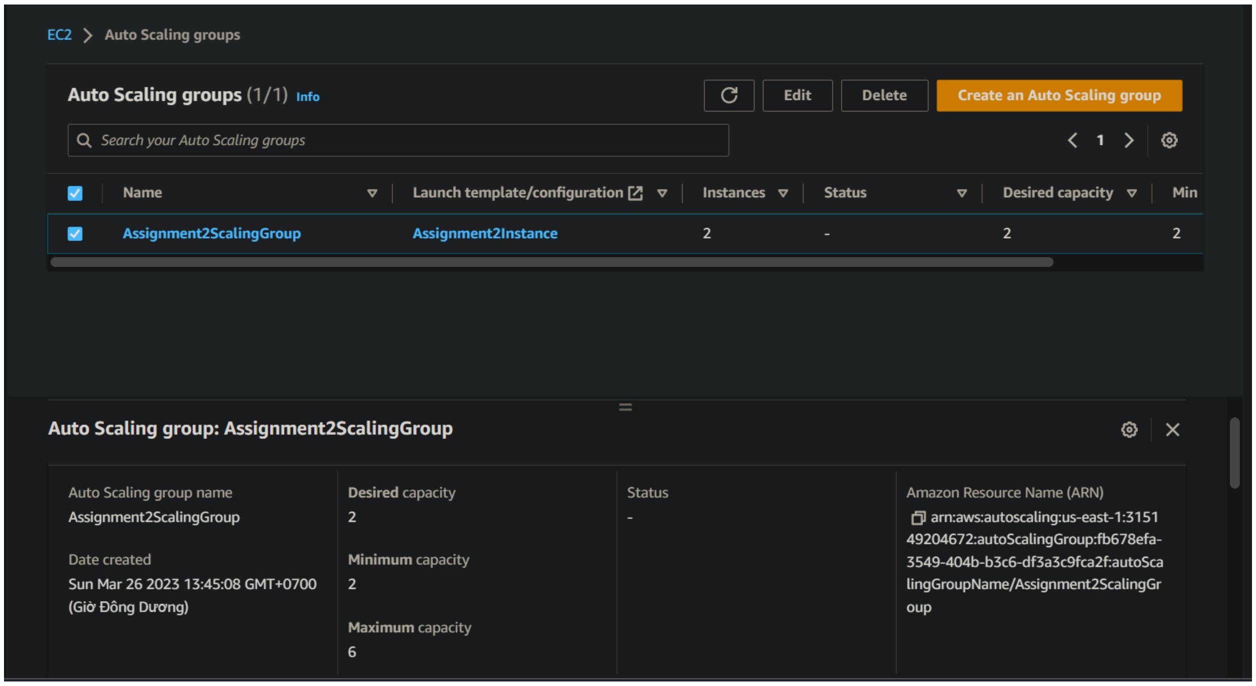
Monitoring Info
- [ ] Enable EC2 instance detailed monitoring within CloudWatch

Advanced details

Later, if you want to use a different launch configuration, you can create a new one and apply it to any Auto Scaling group. Existing launch configurations cannot be edited.

Figure 29: IAM configuration

After that we can create an Auto Scaling Group that will control the Web Server Instance.


EC2 > Auto Scaling groups

Auto Scaling groups (1/1) Info

Search your Auto Scaling groups

Name	Launch template/configuration	Instances	Status	Desired capacity	Min
Assignment2ScalingGroup	Assignment2Instance	2	-	2	2

Auto Scaling group: Assignment2ScalingGroup

Auto Scaling group name
Assignment2ScalingGroup

Date created
Sun Mar 26 2023 13:45:08 GMT+0700 (Giờ Đông Dương)

Desired capacity
2

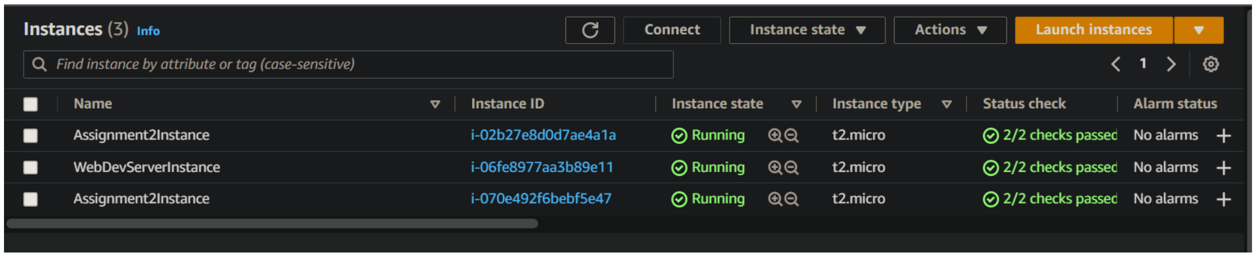
Minimum capacity
2

Maximum capacity
6

Status
-

Amazon Resource Name (ARN)
arn:aws:autoscaling:us-east-1:315149204672:autoScalingGroup:fb678efa-3549-404b-b3c6-df3a3c9fca2f:autoScalingGroupName/Assignment2ScalingGroup

Figure 30: Auto Scaling Group

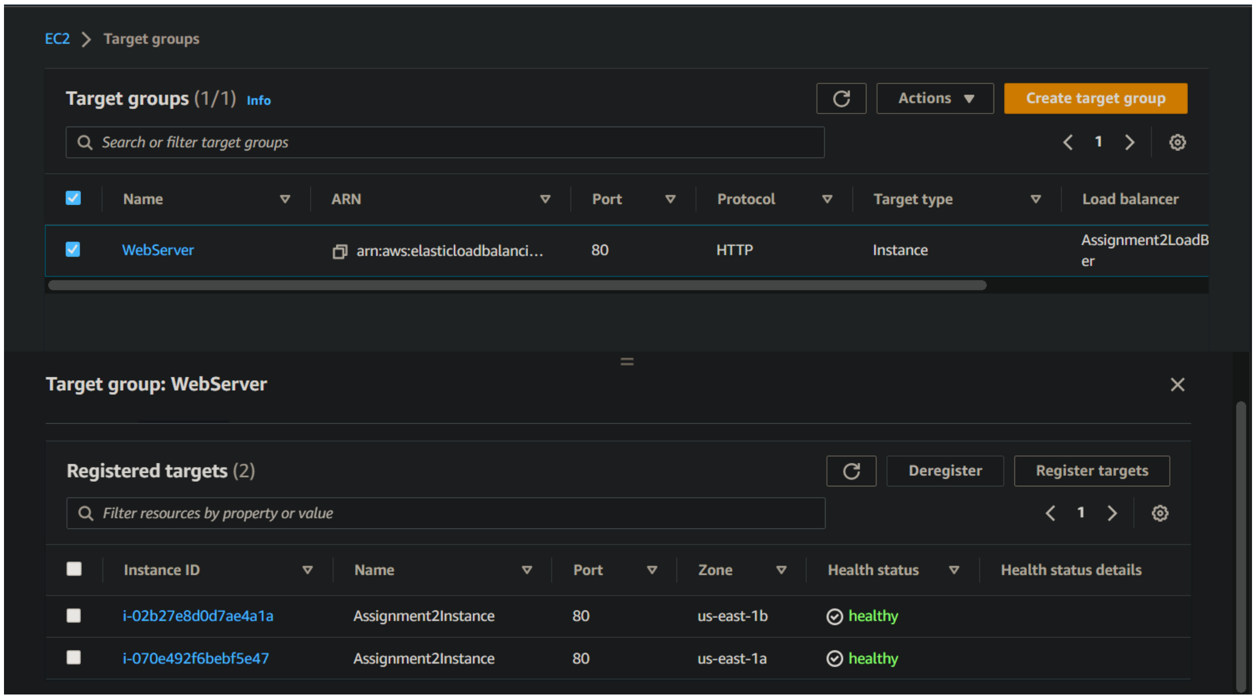

Instances (3) Info

Find instance by attribute or tag (case-sensitive)

Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Assignment2Instance	i-02b27e8d0d7ae4a1a	Running	t2.micro	2/2 checks passed	No alarms
WebDevServerInstance	i-06fe8977aa3b89e11	Running	t2.micro	2/2 checks passed	No alarms
Assignment2Instance	i-070e492f6bebf5e47	Running	t2.micro	2/2 checks passed	No alarms

Figure 31: 2 Assignment2Instance creating from Auto Scaling Group.

A Target group will also be required to launch the load balancer.


EC2 > Target groups

Target groups (1/1) Info

Search or filter target groups

Name	ARN	Port	Protocol	Target type	Load balancer
WebServer	arn:aws:elasticloadbalanci...	80	HTTP	Instance	Assignment2LoadBalancer

Target group: WebServer

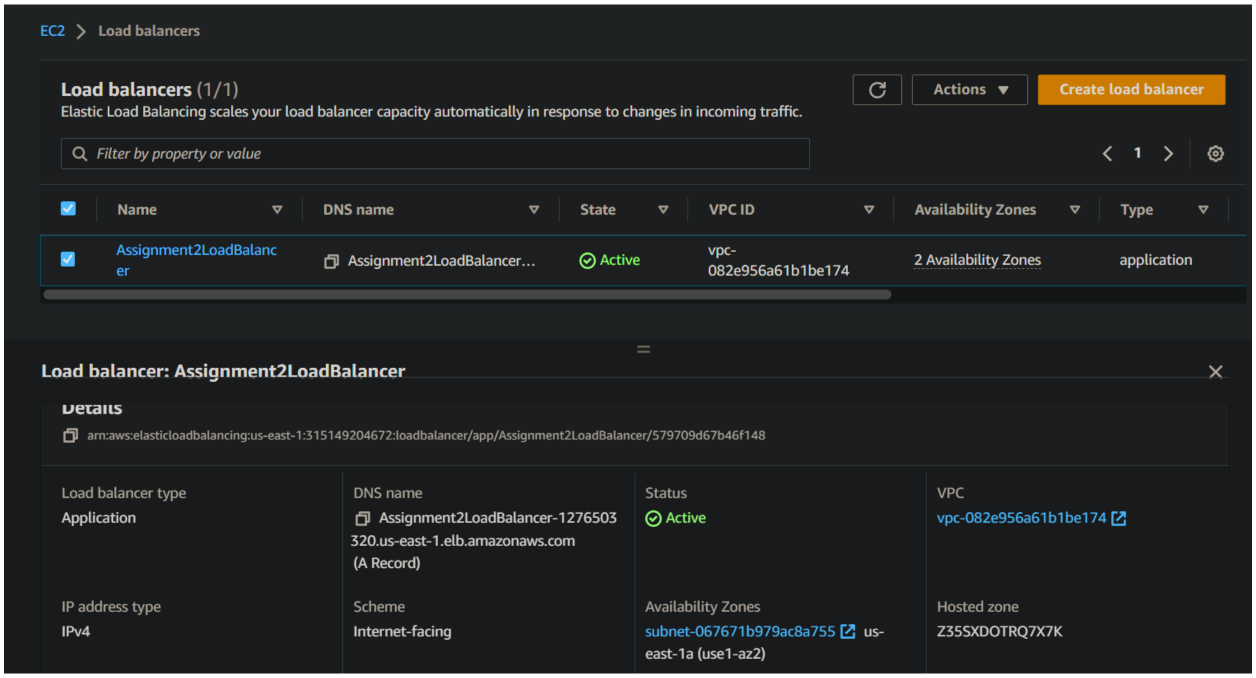
Registered targets (2)

Filter resources by property or value

Instance ID	Name	Port	Zone	Health status	Health status details
i-02b27e8d0d7ae4a1a	Assignment2Instance	80	us-east-1b	healthy	
i-070e492f6bebf5e47	Assignment2Instance	80	us-east-1a	healthy	

Figure 32: Target groups that will be attached to the Load Balancer.

Our Load Balancer will look like this.



EC2 > Load balancers

Load balancers (1/1)

Elastic Load Balancing scales your load balancer capacity automatically in response to changes in incoming traffic.

Name	DNS name	State	VPC ID	Availability Zones	Type
Assignment2LoadBalancer	Assignment2LoadBalancer...	Active	vpc-082e956a61b1be174	2 Availability Zones	application

Load balancer: Assignment2LoadBalancer

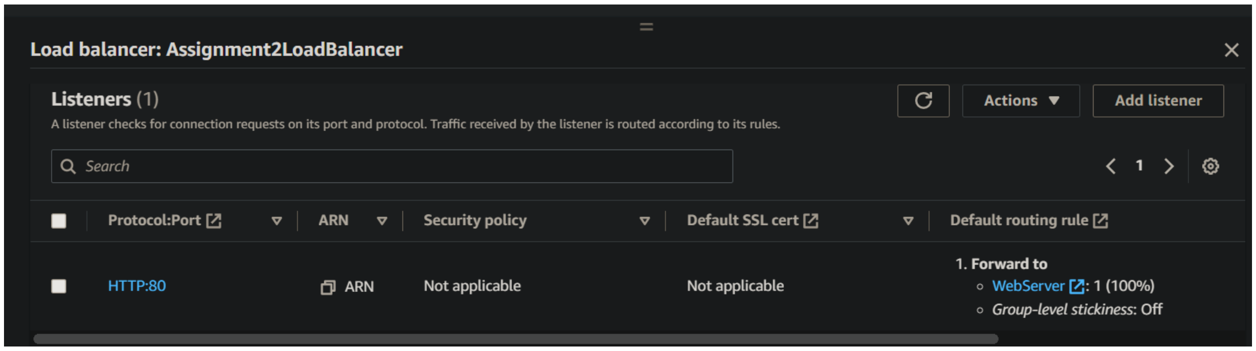
Details

arn:aws:elasticloadbalancing:us-east-1:315149204672:loadbalancer/app/Assignment2LoadBalancer/579709d67b46f148

Load balancer type	DNS name	Status	VPC
Application	Assignment2LoadBalancer-1276503320.us-east-1.elb.amazonaws.com (A Record)	Active	vpc-082e956a61b1be174
IP address type	**Scheme**	**Availability Zones**	**Hosted zone**
IPv4	Internet-facing	subnet-067671b979ac8a755 us-east-1a (use1-az2)	Z35SXDOTRQ7X7K

Figure 33: Load Balancer

The listener of this load balancer will forward to the target group created above.



Load balancer: Assignment2LoadBalancer

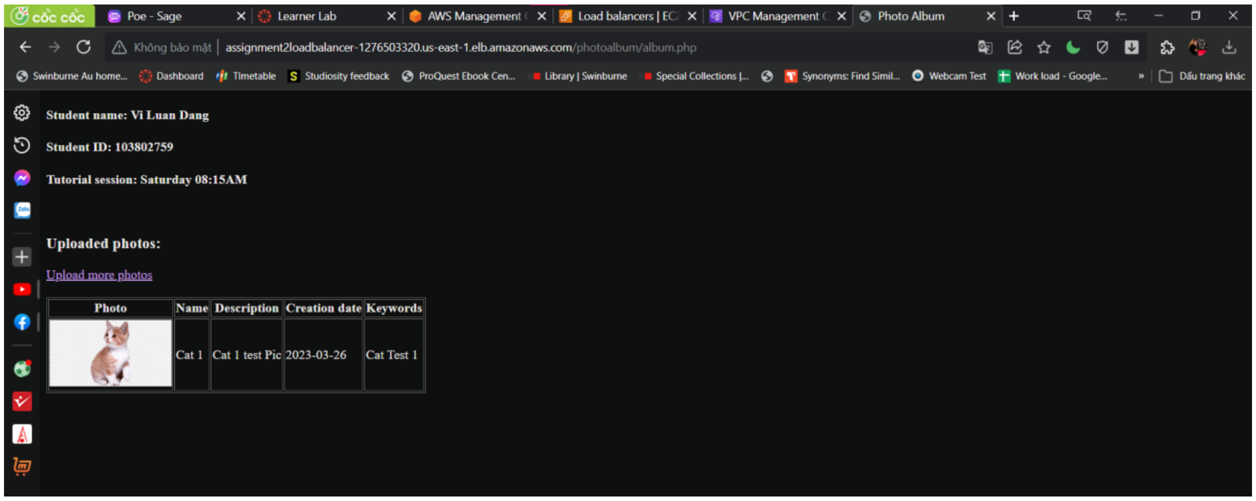
Listeners (1)

A listener checks for connection requests on its port and protocol. Traffic received by the listener is routed according to its rules.

Protocol:Port	ARN	Security policy	Default SSL cert	Default routing rule
HTTP:80	ARN	Not applicable	Not applicable	1. Forward to ◦ WebServer: 1 (100%) ◦ *Group-level stickiness*: Off

Figure 34: Listener of Load Balancer.

We can then use the DNS name provided by the Load Balancer to access our Web Server Instances created by the Auto Scaling Group.



Student name: Vi Luan Dang

Student ID: 103802759

Tutorial session: Saturday 08:15AM

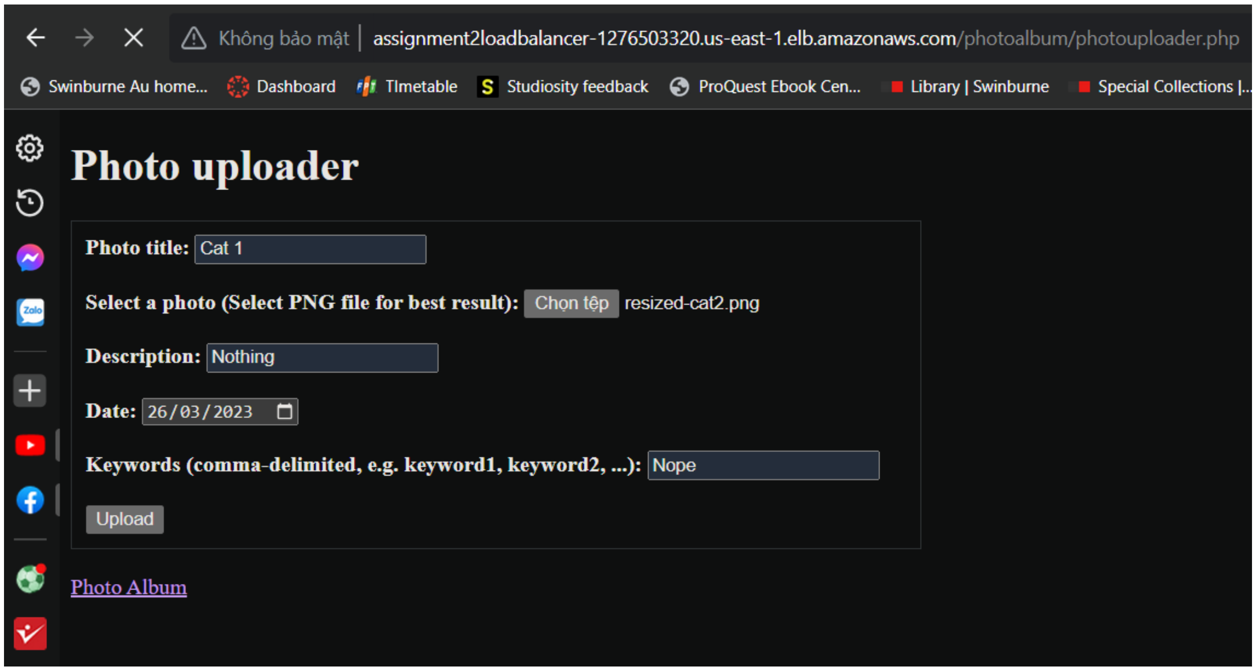
Uploaded photos:

Upload more photos

Photo	Name	Description	Creation date	Keywords
	Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1

Figure 35: Album.php accessed from the Load Balancer

As the S3 Bucket will only allow access from the Load Balancer that we just created, the picture of a cute cat will be presented. We can also upload more cute cats to test the functionality of our website.



assignment2loadbalancer-1276503320.us-east-1.elb.amazonaws.com/photoalbum/photouploader.php

Photo uploader

Photo title: Cat 1

Select a photo (Select PNG file for best result): Chọn tệp resized-cat2.png

Description: Nothing

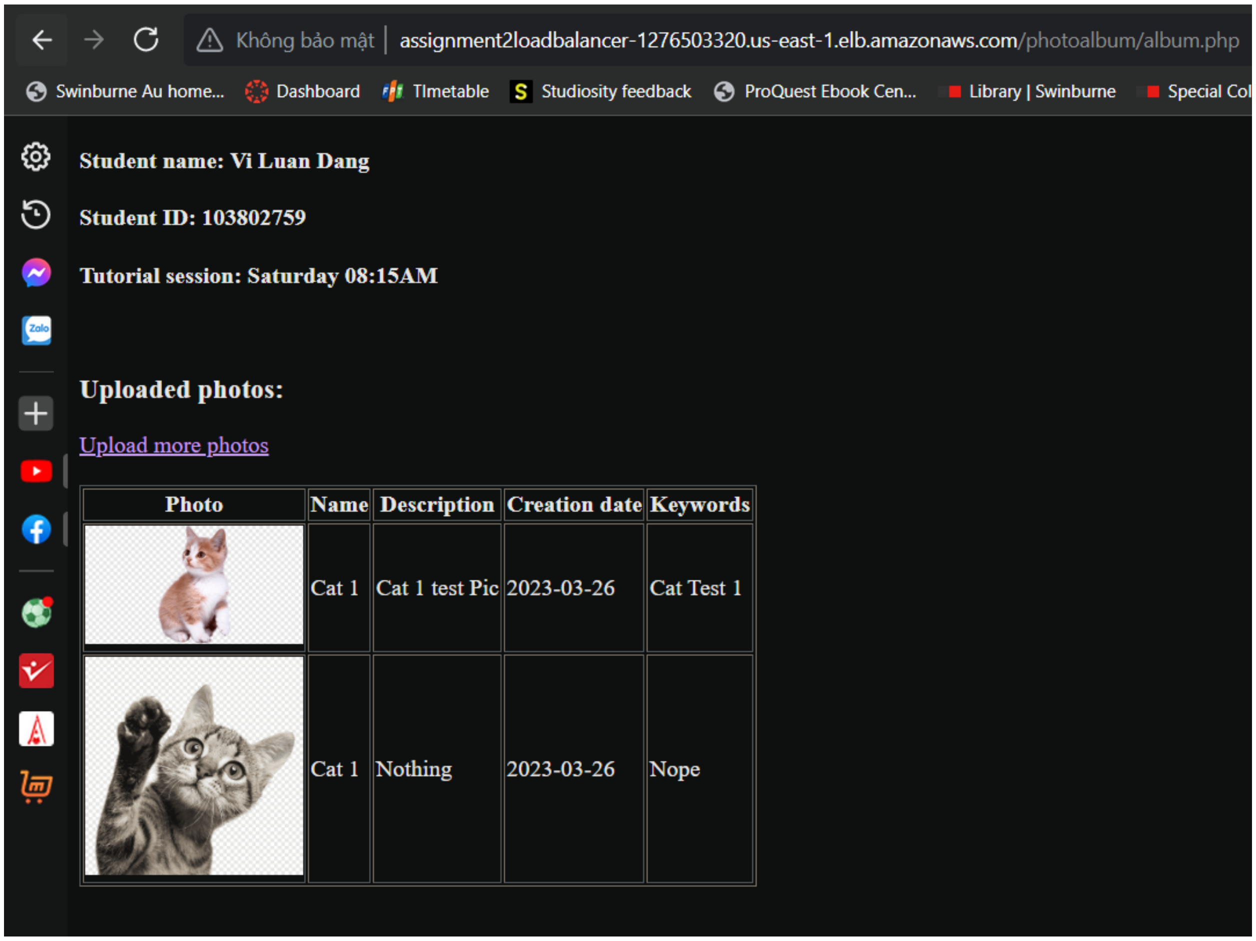
Date: 26/03/2023

Keywords (comma-delimited, e.g. keyword1, keyword2, ...): Nope

Upload

Photo Album

Figure 36: photouploader.php accessed from the Load Balancer


Không bảo mật | assignment2loadbalancer-1276503320.us-east-1.elb.amazonaws.com/photoalbum/album.php
Swinburne Au home... Dashboard Timetable Studiosity feedback ProQuest Ebook Cen... Library | Swinburne Special Col

Student name: Vi Luan Dang

Student ID: 103802759

Tutorial session: Saturday 08:15AM

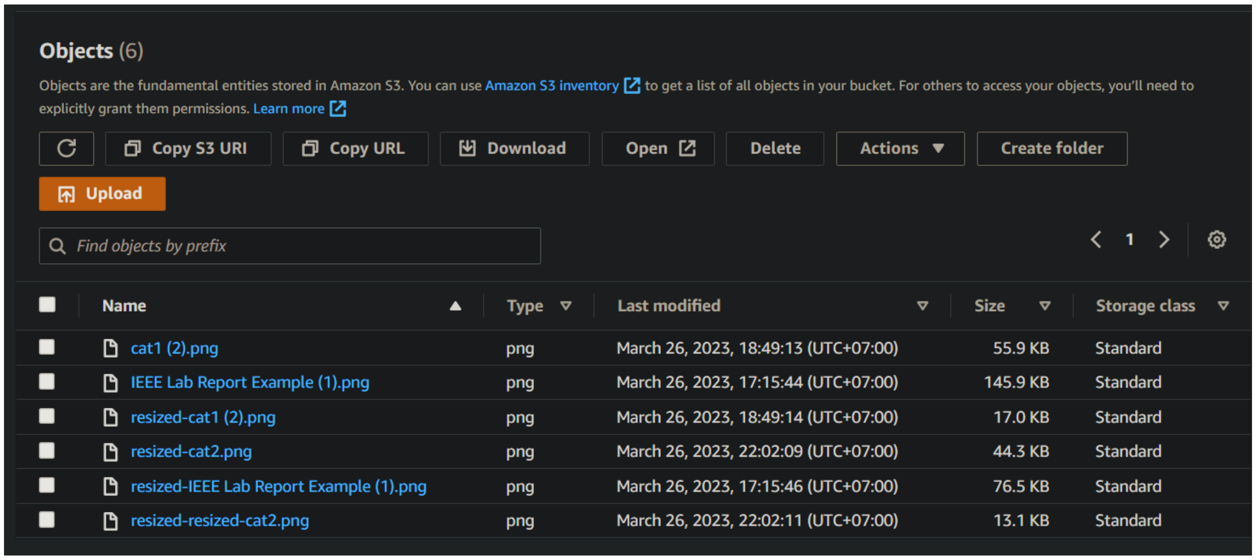
Uploaded photos:

Upload more photos

Photo	Name	Description	Creation date	Keywords
	Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1
	Cat 1	Nothing	2023-03-26	Nope

Figure 37: Functionalities test from Load Balancer.

S3 and the database from phpMyAdmin also work with the Load Balancer.

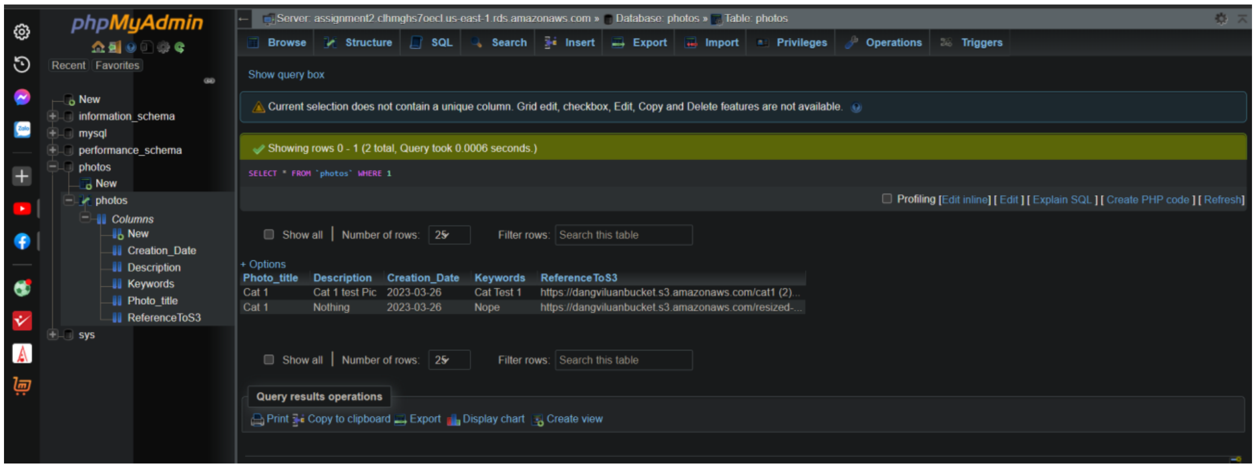


Objects (6)

Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

Name	Type	Last modified	Size	Storage class
cat1 (2).png	png	March 26, 2023, 18:49:13 (UTC+07:00)	55.9 KB	Standard
IEEE Lab Report Example (1).png	png	March 26, 2023, 17:15:44 (UTC+07:00)	145.9 KB	Standard
resized-cat1 (2).png	png	March 26, 2023, 18:49:14 (UTC+07:00)	17.0 KB	Standard
resized-cat2.png	png	March 26, 2023, 22:02:09 (UTC+07:00)	44.3 KB	Standard
resized-IEEE Lab Report Example (1).png	png	March 26, 2023, 17:15:46 (UTC+07:00)	76.5 KB	Standard
resized-resized-cat2.png	png	March 26, 2023, 22:02:11 (UTC+07:00)	13.1 KB	Standard

Figure 38: Cat 2.png and its resized picture is recorded.



Server: assignment2.clhmghs7oecl.us-east-1.rds.amazonaws.com » Database: photos » Table: photos

Current selection does not contain a unique column. Grid edit, checkbox, Edit, Copy and Delete features are not available.

Showing rows 0 - 1 (2 total, Query took 0.0006 seconds.)

```
SELECT * FROM `photos` WHERE 1
```

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 Filter rows: Search this table

+ Options

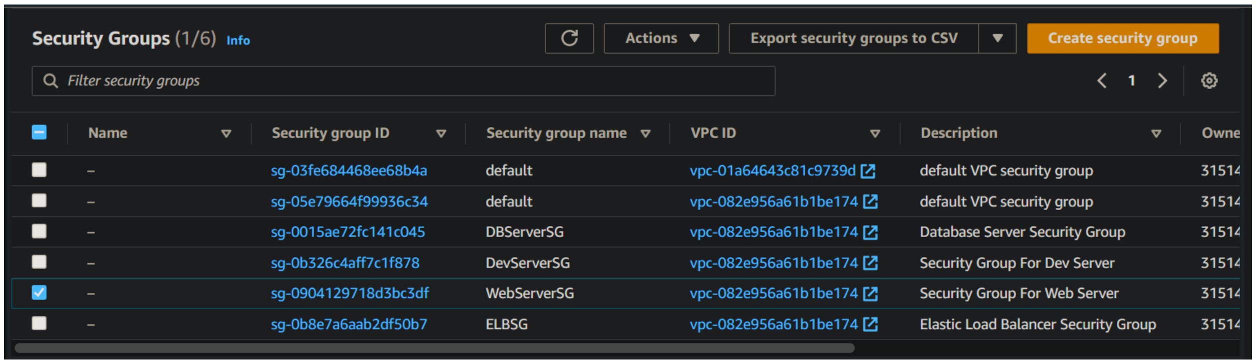
Photo_title	Description	Creation_Date	Keywords	ReferenceToS3
Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1	https://dangviluanbucket.s3.amazonaws.com/cat1 (2)...
Cat 1	Nothing	2023-03-26	Nope	https://dangviluanbucket.s3.amazonaws.com/resized-...

Query results operations

Figure 39: Cat2.png and its meta data is recorded.

VI. Security Group and Network ACL

After making sure that all of our Web Server Instances are working properly, we can then proceed to ensure Security and Accessibility to and from our Web Server Instances.



Name	Security group ID	Security group name	VPC ID	Description	Owne
–	sg-03fe684468ee68b4a	default	vpc-01a64643c81c9739d	default VPC security group	31514
–	sg-05e79664f99936c34	default	vpc-082e956a61b1be174	default VPC security group	31514
–	sg-0015ae72fc141c045	DBServerSG	vpc-082e956a61b1be174	Database Server Security Group	31514
–	sg-0b326c4aff7c1f878	DevServerSG	vpc-082e956a61b1be174	Security Group For Dev Server	31514
–	sg-0904129718d3bc3df	WebServerSG	vpc-082e956a61b1be174	Security Group For Web Server	31514
–	sg-0b8e7a6aab2df50b7	ELBSG	vpc-082e956a61b1be174	Elastic Load Balancer Security Group	31514

Figure 40: Security Groups

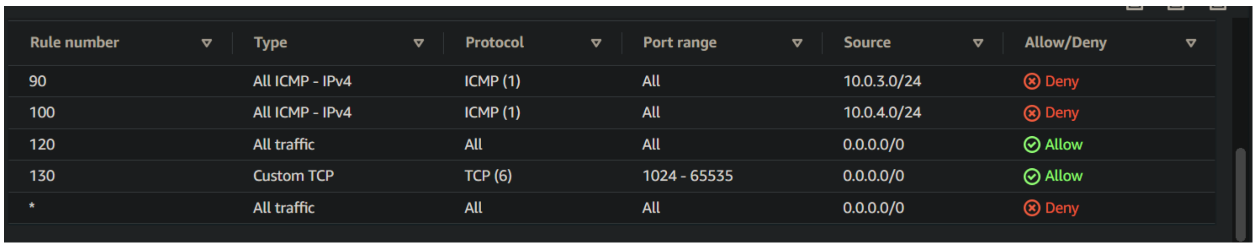
Web Server Security Group should only accept Inbound from Elastic Load Balancer and Outbound to the NAT gateway.

DevServer Security Group can accept Inbound and Outbound from All Traffics.

Database Server Security Group can accept all Inbound and Outbound traffics from the Webserver and the Devserver.

The Elastic Load Balancer Security Group can accept all Inbound and Outbound Traffics from the Internet Gateway.

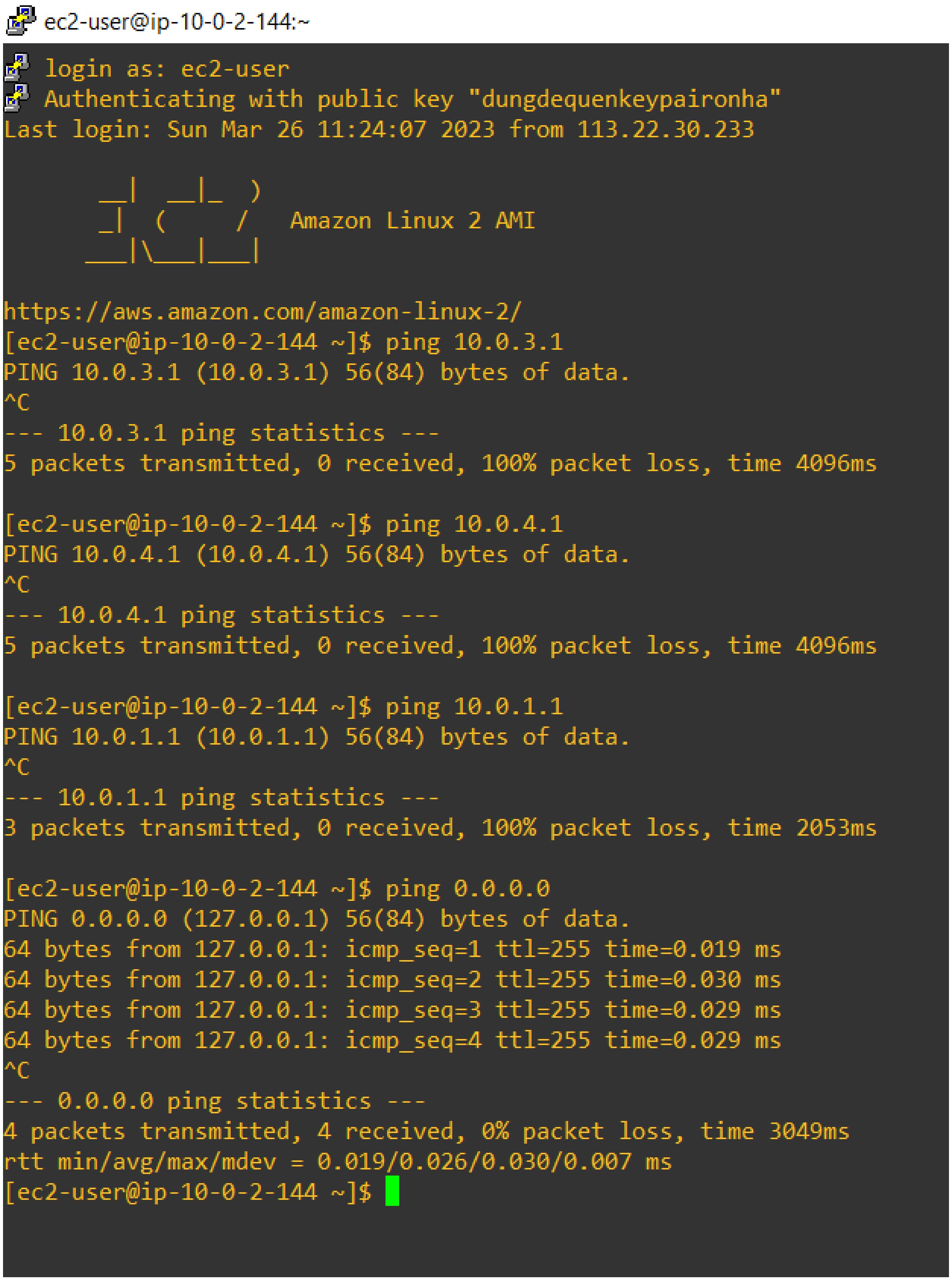
Network ACL is going to be the last part of our configuration, we will create an ACL that will restrict DevServer from sending ICMP packet to the WebServer. The Inbound and Outbound rules for our Network ACL will look like this.



Rule number	Type	Protocol	Port range	Source	Allow/Deny
90	All ICMP - IPv4	ICMP (1)	All	10.0.3.0/24	Deny
100	All ICMP - IPv4	ICMP (1)	All	10.0.4.0/24	Deny
120	All traffic	All	All	0.0.0.0/0	Allow
130	Custom TCP	TCP (6)	1024 - 65535	0.0.0.0/0	Allow
*	All traffic	All	All	0.0.0.0/0	Deny

Figure 41: Network ACLs.

We can SSH into our DevServer to confirm if our Network ACL is working properly.



```
ec2-user@ip-10-0-2-144:~
login as: ec2-user
Authenticating with public key "dungdequenkeypaironha"
Last login: Sun Mar 26 11:24:07 2023 from 113.22.30.233

       __|  __|_  )
       _|  (     /   Amazon Linux 2 AMI
      ___|\___|___|

https://aws.amazon.com/amazon-linux-2/
[ec2-user@ip-10-0-2-144 ~]$ ping 10.0.3.1
PING 10.0.3.1 (10.0.3.1) 56(84) bytes of data.
^C
--- 10.0.3.1 ping statistics ---
5 packets transmitted, 0 received, 100% packet loss, time 4096ms

[ec2-user@ip-10-0-2-144 ~]$ ping 10.0.4.1
PING 10.0.4.1 (10.0.4.1) 56(84) bytes of data.
^C
--- 10.0.4.1 ping statistics ---
5 packets transmitted, 0 received, 100% packet loss, time 4096ms

[ec2-user@ip-10-0-2-144 ~]$ ping 10.0.1.1
PING 10.0.1.1 (10.0.1.1) 56(84) bytes of data.
^C
--- 10.0.1.1 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2053ms

[ec2-user@ip-10-0-2-144 ~]$ ping 0.0.0.0
PING 0.0.0.0 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=255 time=0.019 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=255 time=0.030 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=255 time=0.029 ms
64 bytes from 127.0.0.1: icmp_seq=4 ttl=255 time=0.029 ms
^C
--- 0.0.0.0 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3049ms
rtt min/avg/max/mdev = 0.019/0.026/0.030/0.007 ms
[ec2-user@ip-10-0-2-144 ~]$
```

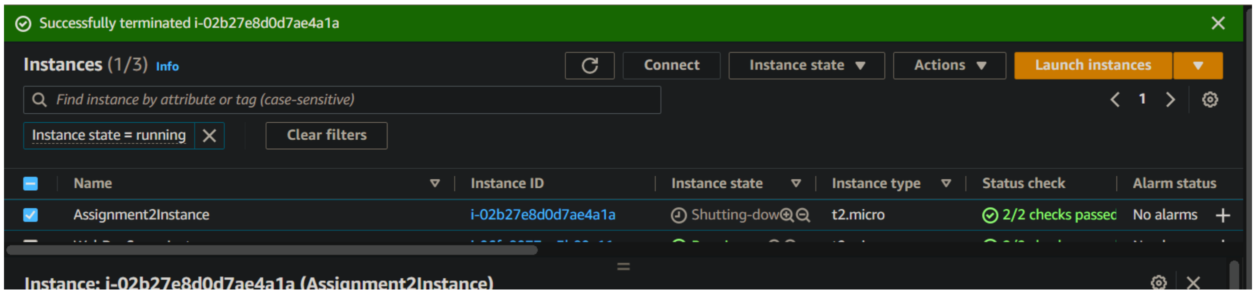
Figure 42: ICMP testing

According to the picture above, we can ping the NAT gateway, which located at 0.0.0.0, but the ICMP sent to private subnet 1(10.0.3.1) and private subnet 2(10.0.4.1) is not reachable. Therefore, our Network ACL is working properly.

VII. Testing

We will perform several tests to see if the functionality of our website is configured properly. Some of the tests have been conducted above and this section will only perform the remaining tests.

Test 1: Termination of Web Instance and Auto Scaling Group



Successfully terminated i-02b27e8d0d7ae4a1a

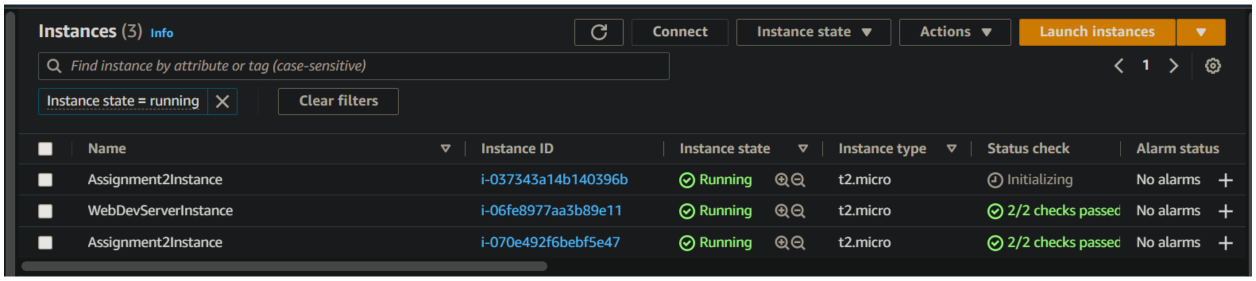
Instances (1/3) Info

Instance state = running

Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Assignment2Instance	i-02b27e8d0d7ae4a1a	Shutting-down	t2.micro	2/2 checks passed	No alarms

Instance: i-02b27e8d0d7ae4a1a (Assignment2Instance)

Figure 43: A Web Instance from the Auto Scaling Group is terminated.

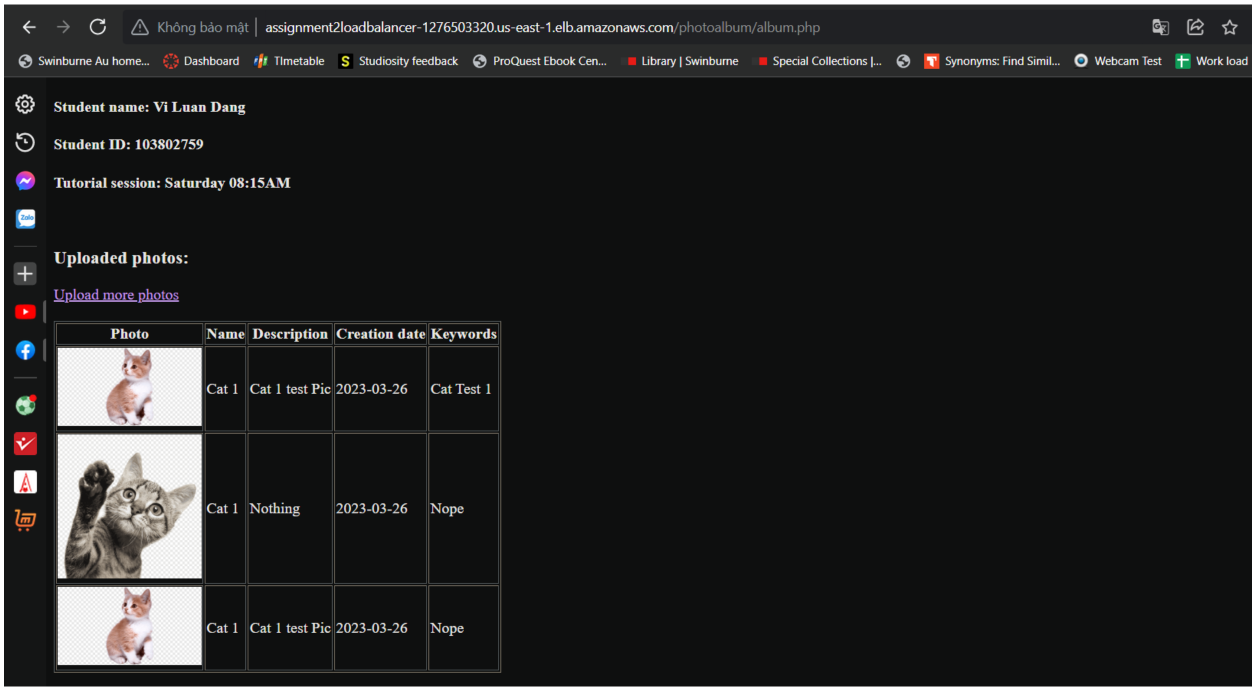


Instances (3) Info

Instance state = running

Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Assignment2Instance	i-037343a14b140396b	Running	t2.micro	Initializing	No alarms
WebDevServerInstance	i-06fe8977aa3b89e11	Running	t2.micro	2/2 checks passed	No alarms
Assignment2Instance	i-070e492f6bebf5e47	Running	t2.micro	2/2 checks passed	No alarms

Figure 44: Another Web Instance is initializing according to the Auto Scaling Group



Student name: Vi Luan Dang

Student ID: 103802759

Tutorial session: Saturday 08:15AM

Uploaded photos:

Upload more photos

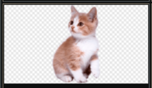
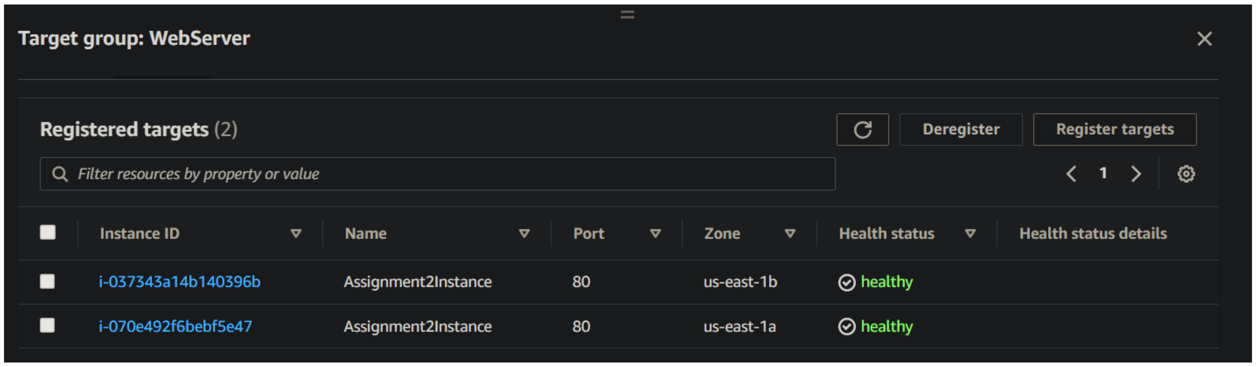
Photo	Name	Description	Creation date	Keywords
	Cat 1	Cat 1 test Pic	2023-03-26	Cat Test 1
	Cat 1	Nothing	2023-03-26	Nope
	Cat 1	Cat 1 test Pic	2023-03-26	Nope

Figure 45: The Load Balancer DNS is still accessible after the termination and initialization of the Web Instance.



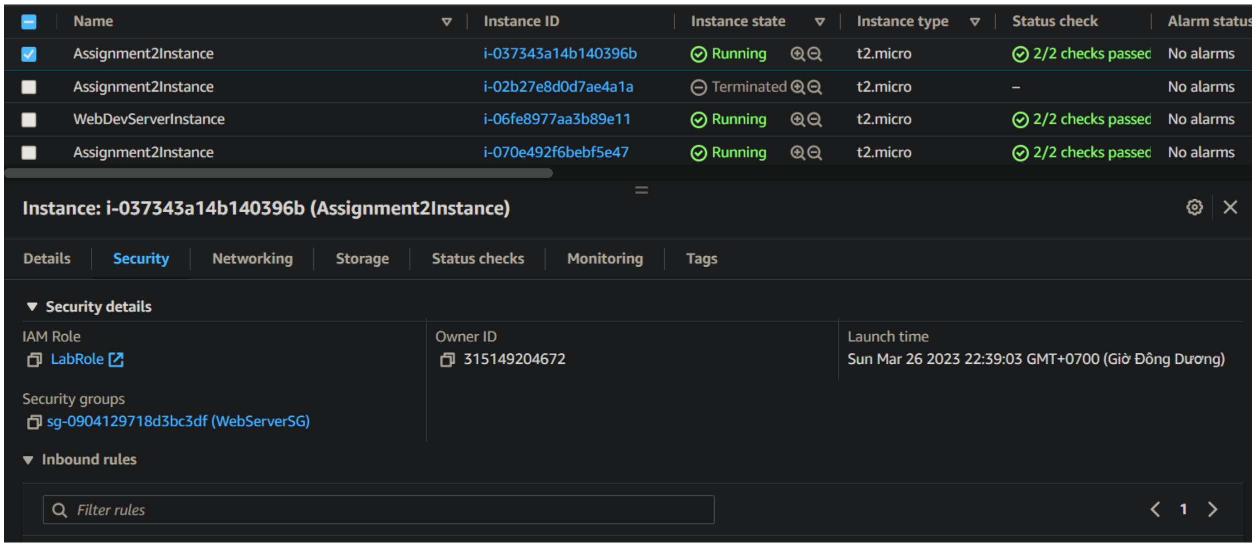
Target group: WebServer

Registered targets (2)

Instance ID	Name	Port	Zone	Health status	Health status details
i-037343a14b140396b	Assignment2Instance	80	us-east-1b	healthy	
i-070e492f6bebf5e47	Assignment2Instance	80	us-east-1a	healthy	

Figure 46: Both Web Instances are healthy.

Test 2: Review of All Security Group and IAM roles.



Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Assignment2Instance	i-037343a14b140396b	Running	t2.micro	2/2 checks passed	No alarms
Assignment2Instance	i-02b27e8d0d7ae4a1a	Terminated	t2.micro	–	No alarms
WebDevServerInstance	i-06fe8977aa3b89e11	Running	t2.micro	2/2 checks passed	No alarms
Assignment2Instance	i-070e492f6bebf5e47	Running	t2.micro	2/2 checks passed	No alarms

Instance: i-037343a14b140396b (Assignment2Instance)

Security details

IAM Role: LabRole

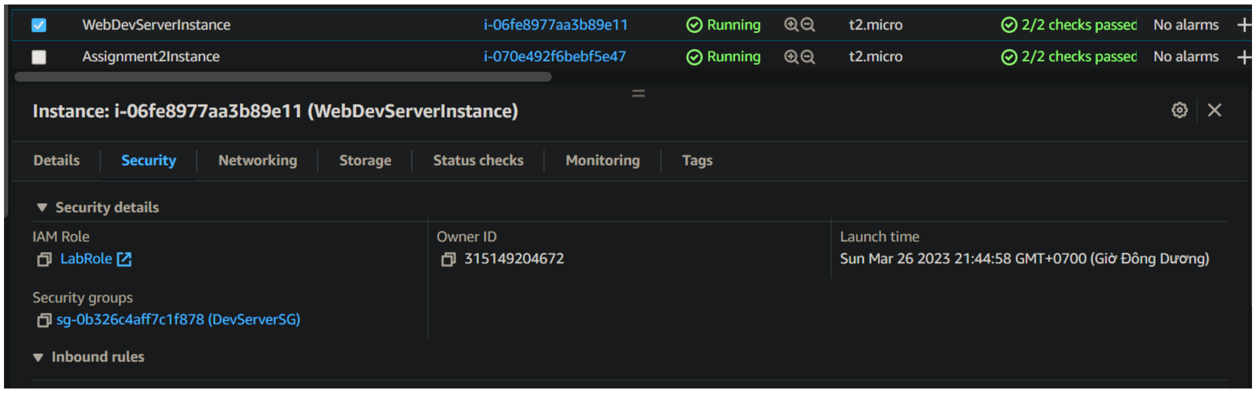
Owner ID: 315149204672

Launch time: Sun Mar 26 2023 22:39:03 GMT+0700 (Giờ Đông Dương)

Security groups: sg-0904129718d3bc3df (WebServerSG)

Inbound rules

Figure 47: Both Web Instances are configured with the according IAM and Security Group.



Name	Instance ID	Instance state	Instance type	Status check	Alarm status
WebDevServerInstance	i-06fe8977aa3b89e11	Running	t2.micro	2/2 checks passed	No alarms
Assignment2Instance	i-070e492f6bebf5e47	Running	t2.micro	2/2 checks passed	No alarms

Instance: i-06fe8977aa3b89e11 (WebDevServerInstance)

Security details

IAM Role: LabRole

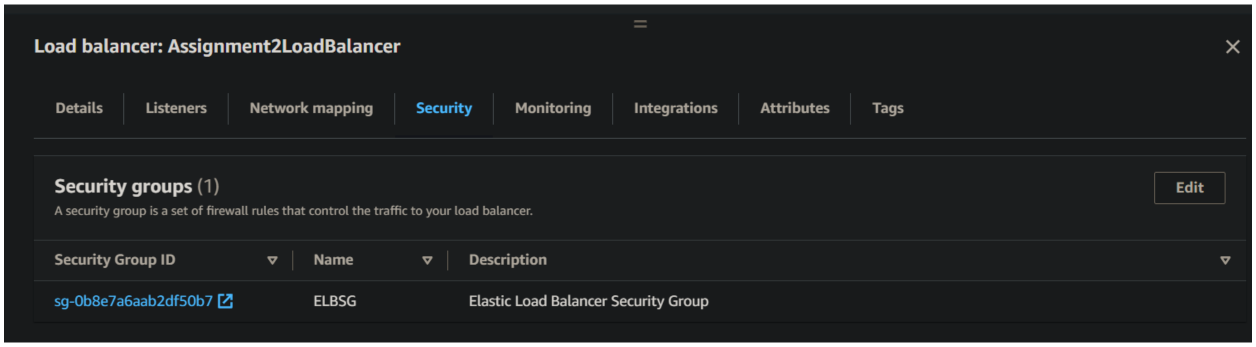
Owner ID: 315149204672

Launch time: Sun Mar 26 2023 21:44:58 GMT+0700 (Giờ Đông Dương)

Security groups: sg-0b326c4aff7c1f878 (DevServerSG)

Inbound rules

Figure 48: WebDevServer is configured with the according IAM and Security Group

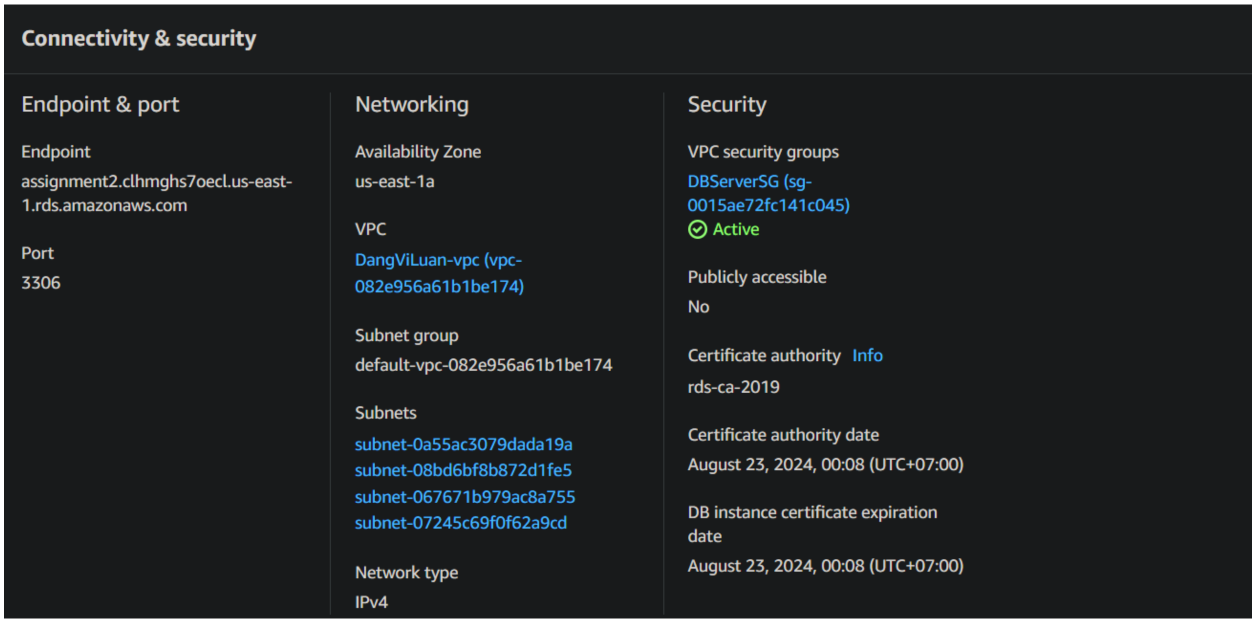

Load balancer: Assignment2LoadBalancer

Security groups (1)

A security group is a set of firewall rules that control the traffic to your load balancer.

Security Group ID	Name	Description
sg-0b8e7a6aab2df50b7	ELBSG	Elastic Load Balancer Security Group

Figure 49: Load Balancer is configured with the according Security Group


Connectivity & security

Endpoint & port

Endpoint
assignment2.clhmghs7oecl.us-east-1.rds.amazonaws.com

Port
3306

Networking

Availability Zone
us-east-1a

VPC
DangViLuan-vpc (vpc-082e956a61b1be174)

Subnet group
default-vpc-082e956a61b1be174

Subnets
subnet-0a55ac3079dada19a
subnet-08bd6bf8b872d1fe5
subnet-067671b979ac8a755
subnet-07245c69f0f62a9cd

Network type
IPv4

Security

VPC security groups
DBServerSG (sg-0015ae72fc141c045)
Active

Publicly accessible
No

Certificate authority Info
rds-ca-2019

Certificate authority date
August 23, 2024, 00:08 (UTC+07:00)

DB instance certificate expiration date
August 23, 2024, 00:08 (UTC+07:00)

Figure 50: RDS is configured with the according Security Group

Link to the ELB album.php: http://assignment2loadbalancer-1276503320.us-east-1.elb.amazonaws.com/photoalbum/album.php

Link to the ELB photouploader.php: http://assignment2loadbalancer-1276503320.us-east-1.elb.amazonaws.com/photoalbum/photouploader.php

Link to the WebDevServer: http://ec2-54-147-64-62.compute-1.amazonaws.com/