Scalable 3-Tier Web Application on AWS

(Designing Robust Web Application on AWS)

Summary: This AWS architecture diagram shows a reliable web application built with three parts. Users find the application through Route 53, a DNS service. The application is protected in a virtual private network (VPC) on AWS, spread across different availability zones to ensure it keeps working even if one zone fails. The user-facing part of the application uses multiple servers (EC2 Instances) for better performance, with an Application Load Balancer (ALB) sharing the traffic evenly. The business logic is handled in another part, possibly using a database service. Data is securely stored in a separate part, using a database service RDS. This setup provides a strong base for web applications on AWS, with the flexibility to add more services for advanced features.

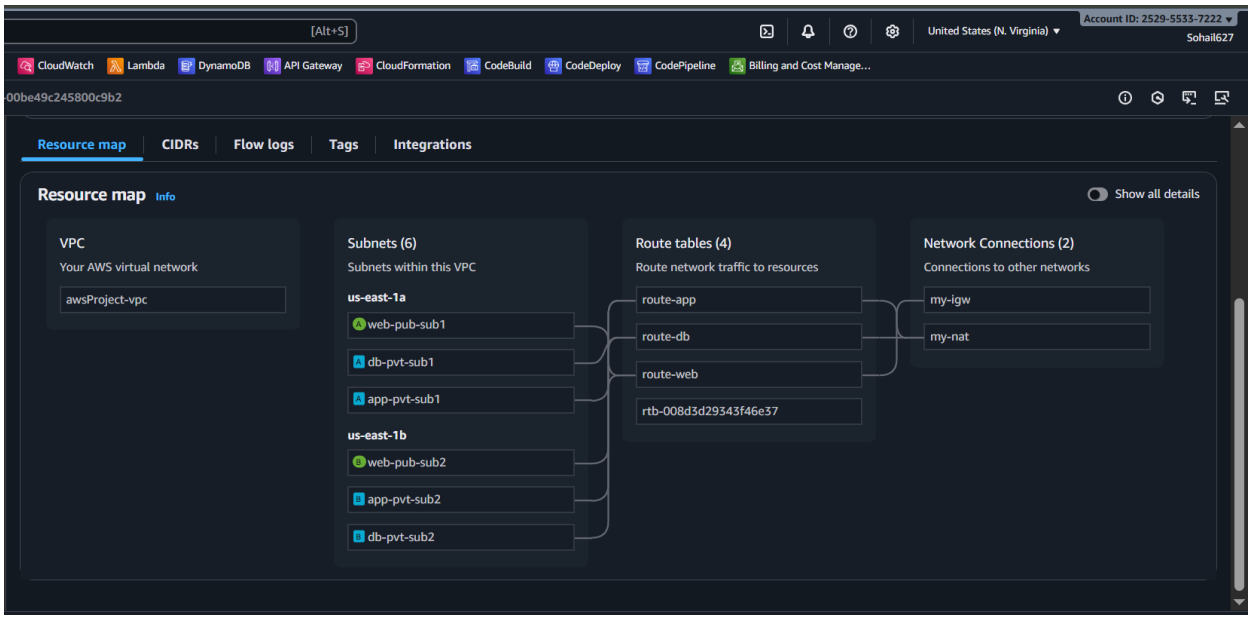
Part 1 :- VPC Construct

- Create a VPC named awsProject-vpcwith a CIDR block of 20.0.0.0/20.
  - `web-pub-sub1`with CIDR block `20.0.1.0/24`in `us-east-1a`
  - `web-pub-sub2`with CIDR block `20.0.2.0/24`in `us-east-1b`
- Create 2 public subnets:
  - `app-pvt-sub1`with CIDR block `20.0.3.0/24`in `us-east-1a`
  - `app-pvt-sub2`with CIDR block `20.0.4.0/24`in `us-east-1b`
- Create 2 private subnets for applications:
  - `db-pvt-sub1`with CIDR block `20.0.5.0/24`in `us-east-1a`
  - db-pvt-sub2with CIDR block `20.0.6.0/24`in `us-east-1b`
- Create 2 private subnets for databases:
- Create a NAT Gateway named my-nat, provide the subnet as web-pub-sub1, and allocate an Elastic IP.
- Create an Internet Gateway named my-igwand attach it to the VPC awsProject-vpc.
- Create 3 route tables named route-web, route-app, and route-db.
- Associate the subnets with the route tables as follows:
  - Select `route-web`and associate it with the subnets `web-pub-sub1`and `web-pub-sub2`.
  - Select `route-app`and associate it with the subnets `app-pvt-sub1`and `app-pvt-sub2`.
  - Select `route-db`and associate it with the subnets `db-pvt-sub1`and `db-pvt-sub2`.

Now add the routes Select route-web, go to routes and click edit routes, add route select the Destination as 0.0.0.0/0, Target Internet Gateway(my-igw) and click on save changes

Select route-app, go to routes and click edit routes, add route select the Destination as 0.0.0.0/0, Target NAT Gateway(my-nat) and click on save changes

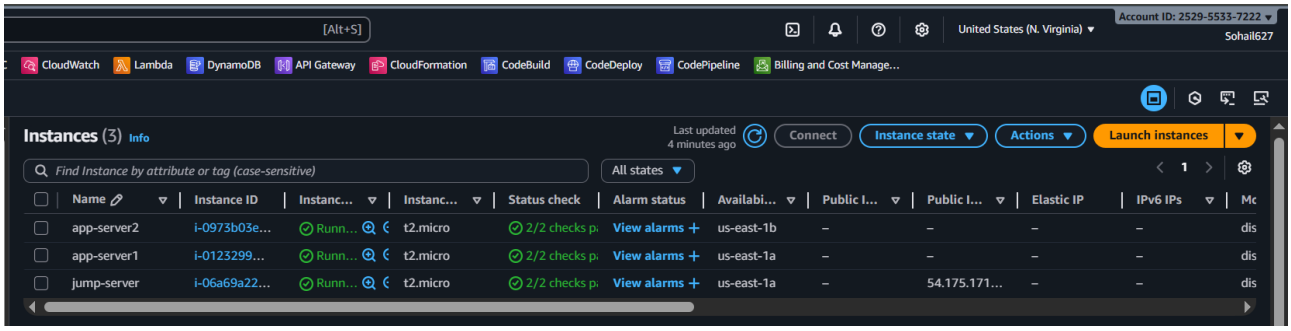
Select route-db, go to routes and click edit routes, add route select the Destination as 0.0.0.0/0, Target NAT Gateway(my-nat) and click on save changes

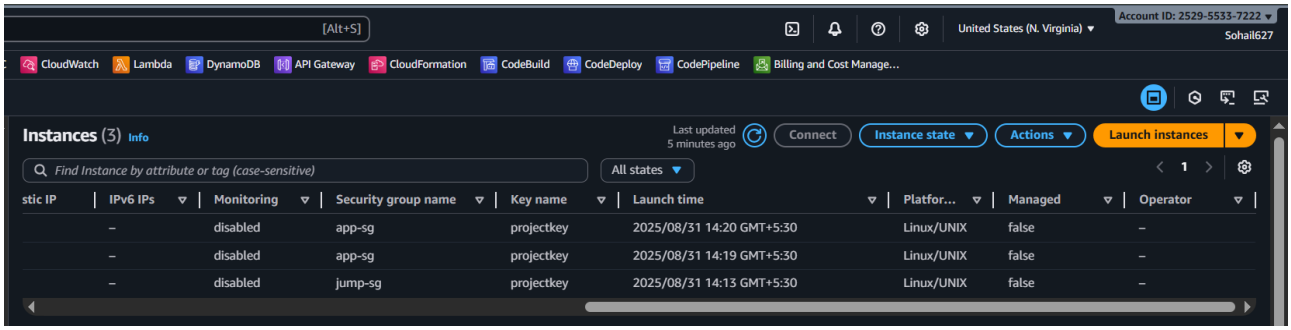


Part 2 :- Ec2 Instances

Create 3 EC2 instances in which 1 in public subnet with publicIP enable which acts as Jump server or bastion host and 2 private subnet with publicIP disable in which we will download phpMyAdmin and apache server

1) Launch an Instance with name jump-server, AMI (Amazon Linux), Instance type (t2.micro), Create a new keypair as (projectkey) , click on edit button on right side of Network settings select vpc(awsProject-vpc), Subnet (web-pub-sub1), Auto-assign IP (Enable), Create security group [Security group name (jump-sg)], allow port SSH (22) and HTTP (80) now Launch instance
2) Create a security group as alb-sg and allow port HTTP (80)
3) Launch an Instance with name app-server1, AMI (Amazon Linux), Instance type (t2.micro), Select the keypair as (projectkey) , click on edit button on right side of Network settings select vpc (awsProject-vpc), Subnet (app-pvt-sub1), Auto-assign IP (Disable), Create security group [Security group name (app-sg)], allow port SSH (22) and Click on Add security group rule select Type (All traffic ,) Source type (Custom) and Source (here select your [alb-sg] you created) now Launch instance
4) Launch an Instance with name app-server2, AMI (Amazon Linux), Instance type (t2.micro), Select the keypair as (projectkey) , click on edit button on right side of Network settings select vpc (awsProject-vpc), Subnet (app-pvt-sub2), Auto-assign IP (Disable), Select existing security group as (app-sg), now Launch instance





Part 3 :- Server configuration

1. Copy the private key in your jump-server instance

```
SOHAIL@SOHAIL MINGW64 /e
$ scp -i projectkey.pem projectkey.pem ec2-user@54.175.171.131:/h
ome/ec2-user/
projectkey.pem                    100% 1674     0.9KB/s   00:01
```

```
[ec2-user@ip-20-0-1-40 ~]$ ls
[ec2-user@ip-20-0-1-40 ~]$ pwd
/home/ec2-user
[ec2-user@ip-20-0-1-40 ~]$ ls
projectkey.pem
[ec2-user@ip-20-0-1-40 ~]$ chmod 400 projectkey.pem
[ec2-user@ip-20-0-1-40 ~]$
```

2. **Now ssh into app-server1 and run the below commands**

```
[ec2-user@ip-20-0-1-40 ~]$ ssh -i projectkey.pem ec2-user@20.0.3.30
The authenticity of host '20.0.3.30 (20.0.3.30)' can't be established.
ED25519 key fingerprint is SHA256:1++68a+ZOdSJTO4PUlvzbzbCIjJgIIkL+a9I
t+rE1sI.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
es
Warning: Permanently added '20.0.3.30' (ED25519) to the list of known
hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-20-0-3-30 ~]$
```

Update the system

>> sudo yum update -y

```
[ec2-user@ip-20-0-3-30 ~]$ sudo yum update -y
Amazon Linux 2023 Kernel Livepatch repository 123 kB/s |  19 kB     00:00
Dependencies resolved.
Nothing to do.
Complete!
```

Install PHP 8.2

>> sudo dnf install php8.2

```
[ec2-user@ip-20-0-3-30 ~]$ sudo dnf install php8.2
Last metadata expiration check: 0:00:20 ago on Sun Aug 31 09:14:42 2025.
Dependencies resolved.
================================================================================
 Package               Arch     Version                    Repository     Size
================================================================================
Installing:
 php8.2                x86_64   8.2.29-1.amzn2023.0.1      amazonlinux   9.7 k
Installing dependencies:
```

>> sudo yum install php8.2-mysqlnd

```
[ec2-user@ip-20-0-3-30 ~]$ sudo yum install php8.2-mysqlnd
Last metadata expiration check: 0:00:57 ago on Sun Aug 31 09:14:42 2025.
Dependencies resolved.
================================================================================
 Package           Arch      Version                     Repository      Size
================================================================================
Installing:
 php8.2-mysqlnd    x86_64    8.2.29-1.amzn2023.0.1       amazonlinux    148 k

Transaction Summary
================================================================================
Install  1 Package

Total download size: 148 k
Installed size: 442 k
Is this ok [y/N]: y
Downloading Packages:
```

Install Apache Web Server

>> sudo yum install -y httpd

Start and Enable Apache

>> sudo systemctl start httpd

>> sudo systemctl enable httpd

>> sudo systemctl is-enabled httpd

```
[ec2-user@ip-20-0-3-30 ~]$ sudo yum install -y httpd
Last metadata expiration check: 0:01:20 ago on Sun Aug 31 09:14:42 2025.
Package httpd-2.4.64-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-3-30 ~]$ sudo systemctl start httpd
[ec2-user@ip-20-0-3-30 ~]$ sudo systemctl enable httpd
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service → /u
sr/lib/systemd/system/httpd.service.
[ec2-user@ip-20-0-3-30 ~]$ sudo systemctl is-enabled httpd
enabled
```

Add User to Apache Group

>> sudo usermod -a -G apache ec2-user

Change Ownership and Permissions for Web Directory

>> sudo chown -R ec2-user:apache /var/www

>> sudo chmod 2775 /var/www && find /var/www -type d -exec sudo chmod 2775 {} \;

>> find /var/www -type f -exec sudo chmod 0664 {} \;

```
[ec2-user@ip-20-0-3-30 ~]$ sudo usermod -a -G apache ec2-user
[ec2-user@ip-20-0-3-30 ~]$ sudo chown -R ec2-user:apache /var/www
[ec2-user@ip-20-0-3-30 ~]$ sudo chmod 2775 /var/www && find /var/www -type d -
exec sudo chmod 2775 {} \;
[ec2-user@ip-20-0-3-30 ~]$ find /var/www -type f -exec sudo chmod 0664 {} \;
[ec2-user@ip-20-0-3-30 ~]$
```

Install Additional PHP Modules

>> sudo yum install php-mbstring php-xml -y

>> sudo yum install php-fpm

```
[ec2-user@ip-20-0-3-30 ~]$ sudo yum install php-mbstring php-xml -y
Last metadata expiration check: 1:00:08 ago on Sun Aug 31 09:14:42 2025.
Package php8.2-mbstring-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Package php8.2-xml-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-3-30 ~]$ sudo yum install php-fpm
Last metadata expiration check: 1:00:20 ago on Sun Aug 31 09:14:42 2025.
Package php8.2-fpm-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-3-30 ~]$
```

Restart Apache and PHP-FPM

>> sudo systemctl restart httpd

>> sudo systemctl restart php-fpm

```
[ec2-user@ip-20-0-3-30 ~]$ sudo systemctl restart httpd
[ec2-user@ip-20-0-3-30 ~]$ sudo systemctl restart php-fpm
```

Download and Set Up phpMyAdmin

>> cd /var/www/html

>> wget https://www.phpmyadmin.net/downloads/phpMyAdmin-latest-all-languages.tar.gz

```
[ec2-user@ip-20-0-3-30 ~]$ cd /var/www/html
[ec2-user@ip-20-0-3-30 html]$ wget https://www.phpmyadmin.net/downloads/phpMyAdmin-latest-all-languages.tar.gz
--2025-08-31 10:16:44--  https://www.phpmyadmin.net/downloads/phpMyAdmin-latest-all-languages.tar.gz
Resolving www.phpmyadmin.net (www.phpmyadmin.net)... 79.127.206.207, 79.127.206.234, 2a02:6ea0:c400::53, ...
Connecting to www.phpmyadmin.net (www.phpmyadmin.net)|79.127.206.207|:443... connected.
HTTP request sent, awaiting response... 302 Found
```

>> mkdir phpMyAdmin && tar -xvzf phpMyAdmin-latest-all-languages.tar.gz -C phpMyAdmin --strip-components 1

```
[ec2-user@ip-20-0-3-30 html]$ mkdir phpMyAdmin && tar -xvzf phpMyAdmin-latest-all-languages.tar.gz -C phpMyAdmin --strip-components 1
phpMyAdmin-5.2.2-all-languages/.rtlcssrc.json
phpMyAdmin-5.2.2-all-languages/CONTRIBUTING.md
phpMyAdmin-5.2.2-all-languages/ChangeLog
phpMyAdmin-5.2.2-all-languages/LICENSE
phpMyAdmin-5.2.2-all-languages/README
phpMyAdmin-5.2.2-all-languages/RELEASE-DATE-5.2.2
phpMyAdmin-5.2.2-all-languages/babel.config.json
phpMyAdmin-5.2.2-all-languages/composer.json
phpMyAdmin-5.2.2-all-languages/composer.lock
phpMyAdmin-5.2.2-all-languages/config.sample.inc.php
phpMyAdmin-5.2.2-all-languages/doc/
phpMyAdmin-5.2.2-all-languages/doc/html/
```

>> rm phpMyAdmin-latest-all-languages.tar.gz

```
phpMyAdmin-5.2.2-all-languages/vendor/williamdes/mariadb-mysql-kbs/src/SlimData.php
phpMyAdmin-5.2.2-all-languages/yarn.lock
[ec2-user@ip-20-0-3-30 html]$ rm phpMyAdmin-latest-all-languages.tar.gz
[ec2-user@ip-20-0-3-30 html]$ |
```

Create a Test Page and Test the Server

>> echo "PHP server 1" > /var/www/html/index.html

>> curl http://localhost

```
[ec2-user@ip-20-0-3-30 html]$ echo "PHP server 1" > /var/www/html/index.html
[ec2-user@ip-20-0-3-30 html]$ curl http://localhost
PHP server 1
[ec2-user@ip-20-0-3-30 html]$ exit
logout
Connection to 20.0.3.30 closed.
[ec2-user@ip-20-0-1-40 ~]$ |
```

3. **Now ssh into app-server2 and run the below commands**

```
[ec2-user@ip-20-0-1-40 ~]$ ls
projectkey.pem
[ec2-user@ip-20-0-1-40 ~]$ ssh -i projectkey.pem ec2-user@20.0.4.6
The authenticity of host '20.0.4.6 (20.0.4.6)' can't be established.
ED25519 key fingerprint is SHA256:PH9glSJzYBDWud9Scx/XR31PIv1qh0/GtgdMP8d7dYM.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '20.0.4.6' (ED25519) to the list of known hosts.
       #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-20-0-4-6 ~]$ |
```

Update the system

>> sudo yum update -y

```
[ec2-user@ip-20-0-4-6 ~]$ sudo yum update -y
Amazon Linux 2023 Kernel Livepatch repository 130 kB/s |  19 kB     00:00
Dependencies resolved.
Nothing to do.
Complete!
```

Install PHP 8.2

>> sudo dnf install php8.2

```
[ec2-user@ip-20-0-4-6 ~]$ sudo dnf install php8.2
Last metadata expiration check: 0:00:12 ago on Sun Aug 31 10:24:35 2025.
Dependencies resolved.
================================================================================
 Package               Arch     Version                    Repository     Size
================================================================================
Installing:
 php8.2                x86_64   8.2.29-1.amzn2023.0.1      amazonlinux   9.7 k
Installing dependencies:
 apr                   x86_64   1.7.5-1.amzn2023.0.4       amazonlinux   129 k
```

>> sudo yum install php8.2-mysqlnd

```
[ec2-user@ip-20-0-4-6 ~]$ sudo yum install php8.2-mysqlnd
Last metadata expiration check: 0:00:31 ago on Sun Aug 31 10:24:35 2025.
Dependencies resolved.
================================================================================
 Package           Arch      Version                    Repository      Size
================================================================================
Installing:
 php8.2-mysqlnd    x86_64    8.2.29-1.amzn2023.0.1      amazonlinux    148 k

Transaction Summary
================================================================================
Install  1 Package

Total download size: 148 k
Installed size: 442 k
Is this ok [y/N]: y
Downloading Packages:
```

 # Install Apache Web Server

>> sudo yum install -y httpd

 # Start and Enable Apache

>> sudo systemctl start httpd

>> sudo systemctl enable httpd

>> sudo systemctl is-enabled httpd

```
[ec2-user@ip-20-0-4-6 ~]$ sudo yum install -y httpd
Last metadata expiration check: 0:02:01 ago on Sun Aug 31 10:24:35 2025.
Package httpd-2.4.64-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-4-6 ~]$ sudo systemctl start httpd
[ec2-user@ip-20-0-4-6 ~]$ sudo systemctl enable httpd
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service → /u
sr/lib/systemd/system/httpd.service.
[ec2-user@ip-20-0-4-6 ~]$ sudo systemctl is-enabled httpd
enabled
[ec2-user@ip-20-0-4-6 ~]$
```

 # Add User to Apache Group

>> sudo usermod -a -G apache ec2-user

 # Change Ownership and Permissions for Web Directory

>> sudo chown -R ec2-user:apache /var/www

>> sudo chmod 2775 /var/www && find /var/www -type d -exec sudo chmod 2775 {} \;

>> find /var/www -type f -exec sudo chmod 0664 {} \;

```
[ec2-user@ip-20-0-4-6 ~]$ sudo usermod -a -G apache ec2-user
[ec2-user@ip-20-0-4-6 ~]$ sudo chown -R ec2-user:apache /var/www
[ec2-user@ip-20-0-4-6 ~]$ sudo chmod 2775 /var/www && find /var/www -type d -e
xec sudo chmod 2775 {} \;
[ec2-user@ip-20-0-4-6 ~]$ find /var/www -type f -exec sudo chmod 0664 {} \;
[ec2-user@ip-20-0-4-6 ~]$
```

 # Install Additional PHP Modules

>> sudo yum install php-mbstring php-xml -y

>> sudo yum install php-fpm

 # Restart Apache and PHP-FPM

>> sudo systemctl restart httpd

>> sudo systemctl restart php-fpm

```
[ec2-user@ip-20-0-4-6 ~]$ sudo yum install php-mbstring php-xml -y
Last metadata expiration check: 0:04:19 ago on Sun Aug 31 10:24:35 2025.
Package php8.2-mbstring-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Package php8.2-xml-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-4-6 ~]$ sudo yum install php-fpm
Last metadata expiration check: 0:04:30 ago on Sun Aug 31 10:24:35 2025.
Package php8.2-fpm-8.2.29-1.amzn2023.0.1.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-20-0-4-6 ~]$ sudo systemctl restart httpd
[ec2-user@ip-20-0-4-6 ~]$ sudo systemctl restart php-fpm
[ec2-user@ip-20-0-4-6 ~]$
```

 # Download and Set Up phpMyAdmin

>> cd /var/www/html

>> wget https://www.phpmyadmin.net/downloads/phpMyAdmin-latest-all-languages.tar.gz

```
[ec2-user@ip-20-0-4-6 ~]$ cd /var/www/html
[ec2-user@ip-20-0-4-6 html]$ wget https://www.phpmyadmin.net/downloads/phpMyAd
min-latest-all-languages.tar.gz
--2025-08-31 10:30:55--  https://www.phpmyadmin.net/downloads/phpMyAdmin-lates
t-all-languages.tar.gz
Resolving www.phpmyadmin.net (www.phpmyadmin.net)... 79.127.206.207, 79.127.20
6.234, 2a02:6ea0:c400::54, ...
Connecting to www.phpmyadmin.net (www.phpmyadmin.net)|79.127.206.207|:443... c
onnected.
HTTP request sent, awaiting response... 302 Found
Location: https://files.phpmyadmin.net/phpMyAdmin/5.2.2/phpMyAdmin-5.2.2-all-l
anguages.tar.gz [following]
--2025-08-31 10:30:55--  https://files.phpmyadmin.net/phpMyAdmin/5.2.2/phpMyAd
min-5.2.2-all-languages.tar.gz
Resolving files.phpmyadmin.net (files.phpmyadmin.net)... 109.61.91.230, 109.61
.91.195, 109.61.91.197, ...
Connecting to files.phpmyadmin.net (files.phpmyadmin.net)|109.61.91.230|:443..
```

>> mkdir phpMyAdmin && tar -xvzf phpMyAdmin-latest-all-languages.tar.gz -C phpMyAdmin --strip-components 1

```
[ec2-user@ip-20-0-4-6 html]$ mkdir phpMyAdmin && tar -xvzf phpMyAdmin-latest-a
ll-languages.tar.gz -C phpMyAdmin --strip-components 1
phpMyAdmin-5.2.2-all-languages/.rtlcssrc.json
phpMyAdmin-5.2.2-all-languages/CONTRIBUTING.md
phpMyAdmin-5.2.2-all-languages/ChangeLog
phpMyAdmin-5.2.2-all-languages/LICENSE
phpMyAdmin-5.2.2-all-languages/README
phpMyAdmin-5.2.2-all-languages/RELEASE-DATE-5.2.2
phpMyAdmin-5.2.2-all-languages/babel.config.json
phpMyAdmin-5.2.2-all-languages/composer.json
phpMyAdmin-5.2.2-all-languages/composer.lock
phpMyAdmin-5.2.2-all-languages/config.sample.inc.php
phpMyAdmin-5.2.2-all-languages/doc/
phpMyAdmin-5.2.2-all-languages/doc/html/
```

>> rm phpMyAdmin-latest-all-languages.tar.gz

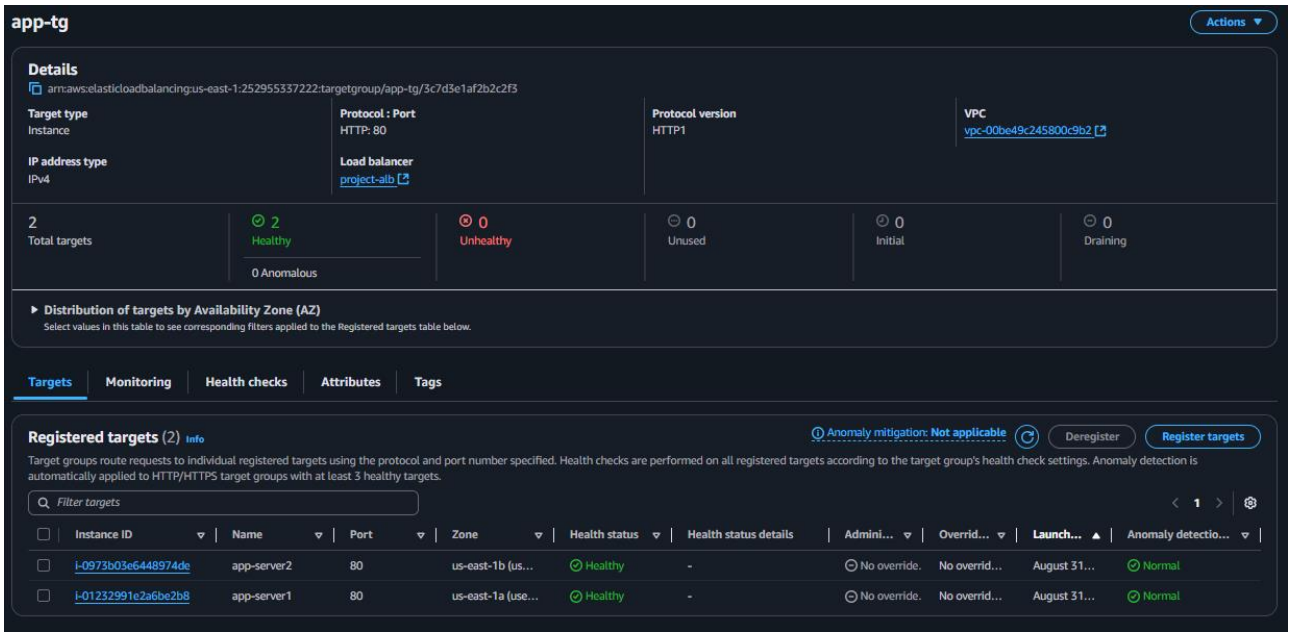
 # Create a Test Page and Test the Server

>> echo "PHP server 2" > /var/www/html/index.html

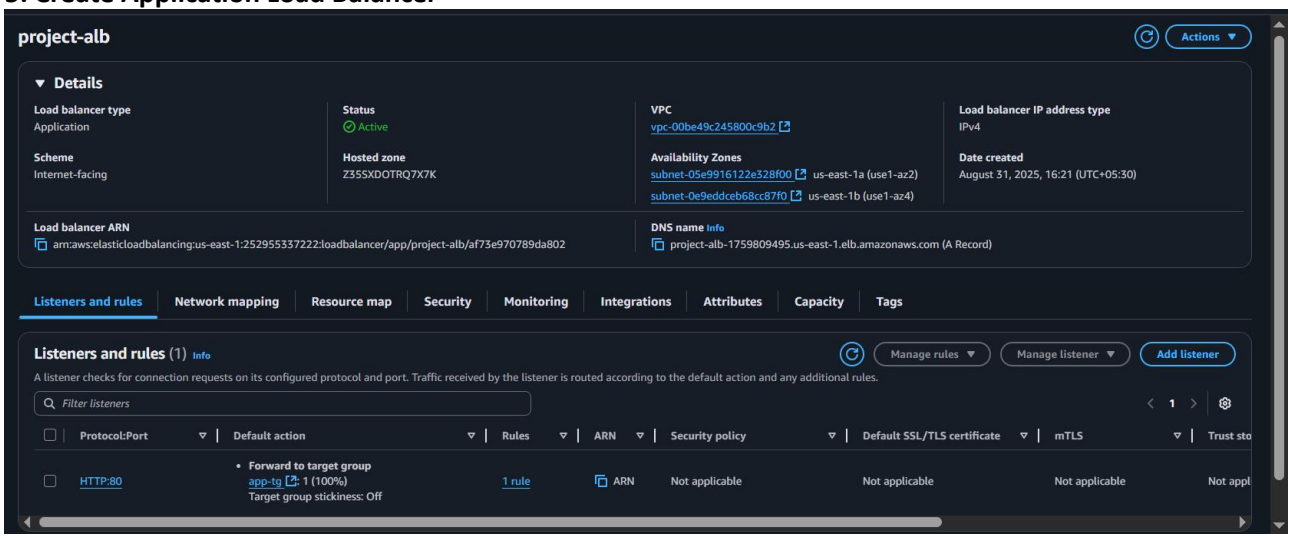
>> curl http://localhost

```
[ec2-user@ip-20-0-4-6 html]$ rm phpMyAdmin-latest-all-languages.tar.gz
[ec2-user@ip-20-0-4-6 html]$ echo "PHP server 2" > /var/www/html/index.html
[ec2-user@ip-20-0-4-6 html]$ curl http://localhost
PHP server 2
[ec2-user@ip-20-0-4-6 html]$
```

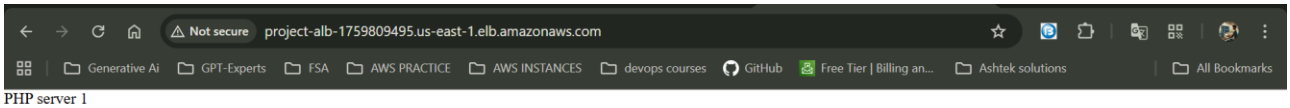
4. Create the Target groups:



5. Create Application Load Balancer

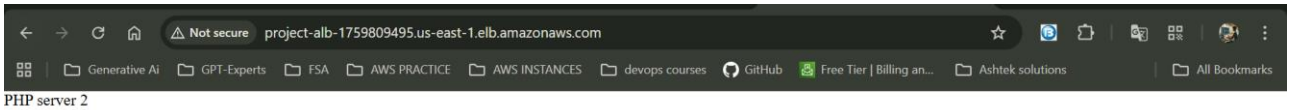


6. Test the Load balancer : Now take the load balancer DNS and past it on chrome browser you should see PHP Server 1 and when you refresh the page it should show PHP Server 2 that means your load balancing is working as expected



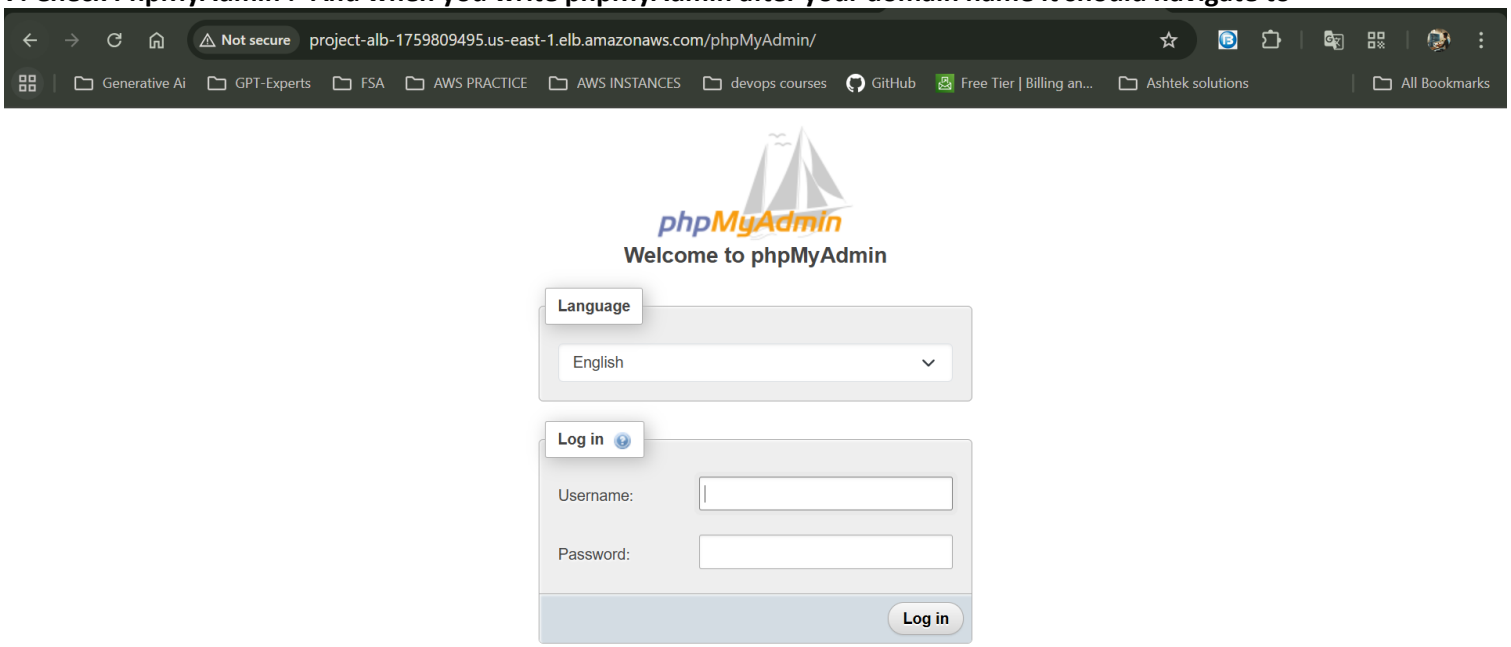
PHP server 1

Refrest the page:



PHP server 2

7. Check PhpMyAdmin :- And when you write phpMyAdmin after your domain name it should navigate to



Part 4 :- Database configurations

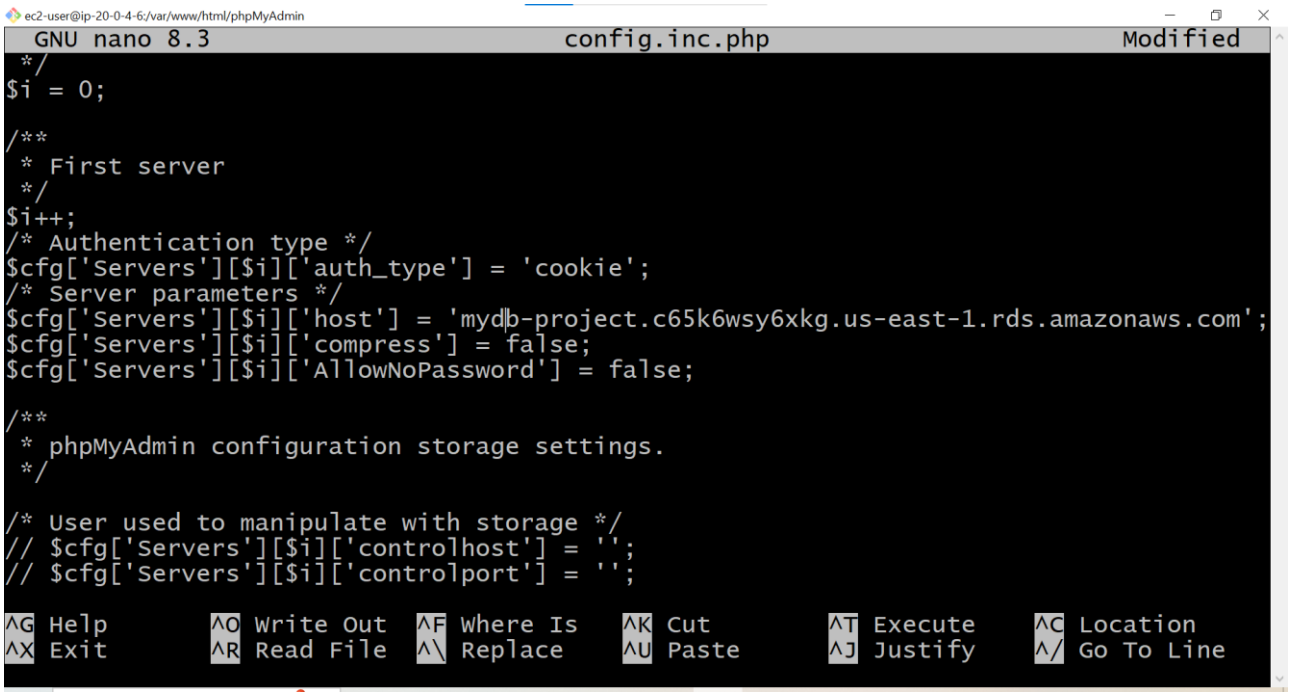
Now copy the Endpoint of RDS cluster and ssh into app-server1 instance and app-server2 instance

>>cd /var/www/html/phpMyAdmin

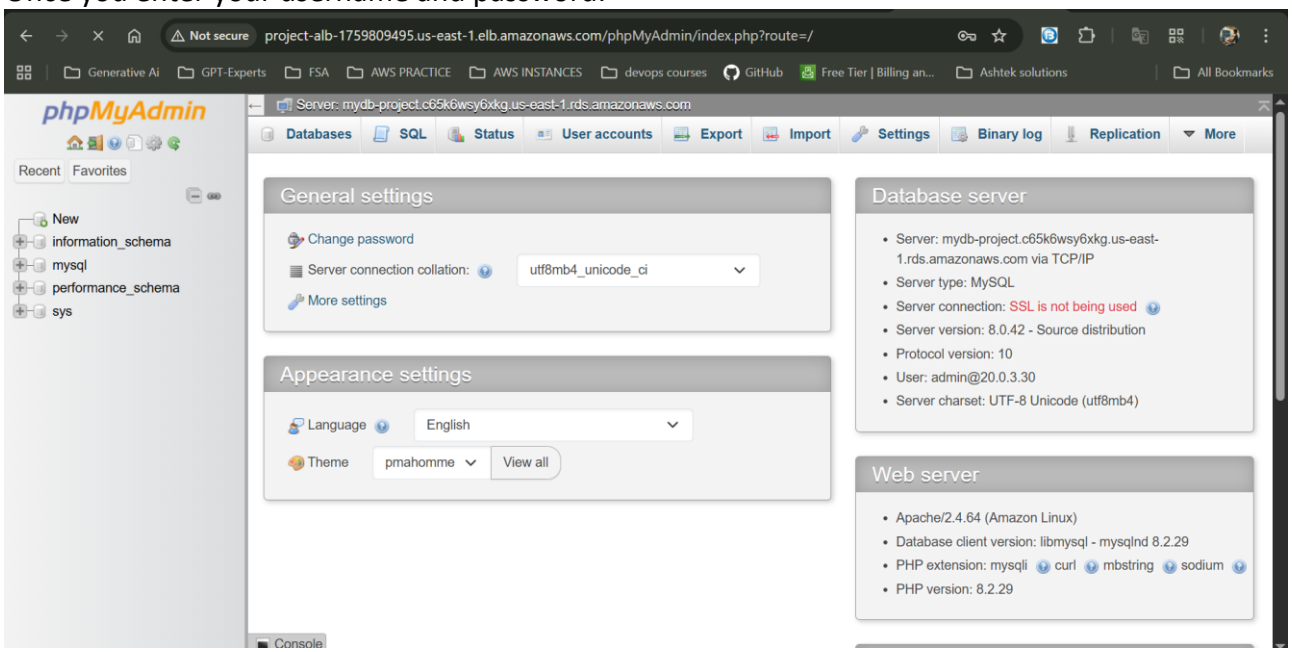
>> mv config.sample.inc.php config.inc.php

>> nano config.inc.php

```
[ec2-user@ip-20-0-4-6 html]$ cd /var/www/html/phpMyAdmin
[ec2-user@ip-20-0-4-6 phpMyAdmin]$ ls
CONTRIBUTING.md     composer.lock         libraries              templates
ChangeLog           config.sample.inc.php locale                 themes
LICENSE             doc                   package.json           url.php
README              examples              robots.txt             vendor
RELEASE-DATE-5.2.2  favicon.ico           setup                  yarn.lock
babel.config.json   index.php             show_config_errors.php
composer.json       js                    sql
[ec2-user@ip-20-0-4-6 phpMyAdmin]$ mv config.sample.inc.php config.inc.php
[ec2-user@ip-20-0-4-6 phpMyAdmin]$ nano config.inc.php
```



Once you enter your username and password:



The end