Practical Lab Guide 3: Deploying a Local Application on EC2 Remote Server Using Ansible

In this exercise, you'll learn how to install and configure Ansible on a control node, manage EC2 instances via Ansible, and automate the deployment of a local Django-React application on a remote server.

Step 1: Installing Ansible on the Control Node

Ansible runs from a control node and manages remote servers (target nodes). This step outlines how to install Ansible on your local machine (the control node). Please note, Ansible cannot be installed on Windows; it requires a Unix-like system such as Linux or macOS.

Add Ansible PPA to your system: This step ensures your system includes the Ansible repository.

```
sudo apt-add-repository ppa:ansible/ansible
```

Update the package index: Refresh the package list to include the newly added Ansible PPA.

```
sudo apt update
```

Install Ansible: Finally, install Ansible using the following command:

```
sudo apt install ansible
```

Ansible is written in Python, so you'll notice that Python will be installed as a dependency.

For windows users :

Since Ansible is designed for Unix-like systems, Windows users can work with Ansible through Docker. This approach allows Windows users to set up a Docker container as the control node for Ansible tasks, without needing a Unix environment on their local machine

Pull the `cytopia/ansible` Docker Image

The `cytopia/ansible` image contains Ansible pre-installed, which is ideal for running playbooks and managing remote nodes.

```
docker pull cytopia/ansible
```

Note: Work in a directory on your local machine as outlined in the following steps. Then, mount this directory as a volume to the Ansible container. From there, you'll be able to run your playbooks directly.

Step 2: Setting Up the Inventory File

The inventory file holds information about the servers (hosts) you'll manage. For this exercise, you'll create an inventory file listing the EC2 instance(s) you want to manage.

Create an Ansible project directory:

```
mkdir ansible
cd ansible
```

Download the **`deployer_key.pem`**:

- This key was generated by Terraform and attached to your EC2 instance.
- After downloading, place the key inside the `ansible` directory.

Set the Key Permissions: (only for linux users)

- The SSH key file should have strict permissions for security.
  `chmod 600 deployer_key.pem`

Create the inventory file: Create a file named `hosts` to define your managed hosts.

```
touch hosts
```

Organize your hosts into groups: An inventory file can group servers for better management. For example:

```
[servers]
server1 ansible_host=203.0.113.111
server2 ansible_host=203.0.113.112
server3 ansible_host=203.0.113.113
```

Set global variables for Python interpreter: If your remote servers use Python 3 (which is common for Ubuntu), you'll need to specify it in the inventory file.

```
[servers:vars]
ansible_python_interpreter=/usr/bin/python3
```

Step 3: Configure the EC2 Instance for Ansible

To connect Ansible to an EC2 instance, you need to define certain details such as the host's IP address, SSH key file, and user information.

Edit the hosts file to include your EC2 instance:

```
[servers]
54.159.37.2 # your ec2 instance public ip address
[servers:vars]
ansible_python_interpreter=/usr/bin/python3
ansible_ssh_private_key_file=deployer_key.pem
ansible_user=ubuntu
```

- **`ansible_python_interpreter`**: Specifies the path to Python 3 on the remote server.
- **`ansible_ssh_private_key_file`**: Refers to the SSH private key used to connect to the EC2 instance.

Step 4: Check the Connection

After setting up the inventory file, check the connection between your control node (local machine) and the remote EC2 instance.

Run the ping command: This command verifies that Ansible can communicate with the remote instance.

ansible all -i hosts -m ping
or
ansible `servers` -i hosts -m ping

You should see a successful response (`pong`).

for windows users : manipulation with ansible container

`cd ansible`
run the ansible container

```
docker run -d -v "full  path of your directory ansible in your machine:/workspace" --name my_ansible_container cytopia/ansible sh -c "while true; do sleep 3600; done"
```

for example :

```
docker run -d -v "C:/ansible:/workspace" --name my_ansible_container cytopia/ansible sh -c "while true; do sleep 3600; done"
```

Explanation of the command:

- **-d**: Runs the container in detached mode.
- **-v** "C:\ansible:/workspace": Mounts the local ansible directory to /workspace inside the container. This allows you to access playbooks and other files within the container.
- **`--name my_ansible_container`:** Assigns a name to the container so you can easily reference it.
- **cytopia/ansible**: Specifies the Docker image.
- `sh -c "while true; do sleep 3600; done"`: Keeps the container running by making it loop indefinitely.

```
then cd /workspace and ls there you can see your mounted files in the container
```

Note: When your container is running in detached mode with a mounted volume, any updates you make to files in the mounted directory on your local machine (e.g., `ansible`) are immediately reflected inside the container. You don't need to restart or reattach the volume; Docker dynamically reflects changes from the host into the container's mounted volume.

Install SSH Client Inside the Container

Ansible requires SSH to connect to remote nodes. Since `cytopia/ansible` doesn't include SSH by default, install the `openssh-client` within the container.

Inside the container, run:

```
apk update && apk add openssh
```

(The `apk` package manager is used for Alpine-based images, which is likely the base for `cytopia/ansible`.)

Verify SSH Installation

After installation, confirm that `ssh` is available by running:

```
ssh -V
```

This should display the version of the SSH client, confirming that it's now installed.

```
/workspace # apk update && apk add openssh
fetch https://dl-cdn.alpinelinux.org/alpine/v3.16/main/x86_64/APKINDEX.tar.gz
fetch https://dl-cdn.alpinelinux.org/alpine/v3.16/community/x86_64/APKINDEX.tar.gz
v3.16.9-124-g7ebe731c813 [https://dl-cdn.alpinelinux.org/alpine/v3.16/main]
v3.16.9-125-gec300a94000 [https://dl-cdn.alpinelinux.org/alpine/v3.16/community]
OK: 17044 distinct packages available
(1/8) Installing openssh-keygen (9.0_p1-r5)
(2/8) Installing libedit (20210910.3.1-r0)
(3/8) Installing openssh-client-common (9.0_p1-r5)
(4/8) Installing openssh-client-default (9.0_p1-r5)
(5/8) Installing openssh-sftp-server (9.0_p1-r5)
(6/8) Installing openssh-server-common (9.0_p1-r5)
(7/8) Installing openssh-server (9.0_p1-r5)
(8/8) Installing openssh (9.0_p1-r5)
Executing busybox-1.35.0-r17.trigger
OK: 83 MiB in 48 packages
/workspace # ssh -V
OpenSSH_9.0p1, OpenSSL 1.1.1w  11 Sep 2023
```

Now lets give the right permissions to the deployer key :

```
chmod 600 deployer_key.pem
```

Run the ping command: This command verifies that Ansible can communicate with the remote instance.
ansible all -i hosts -m ping
or
ansible `servers` -i hosts -m ping
You should see a successful response (pong).

```
/workspace # chmod 600 deployer_key.pem
/workspace # ansible all -i hosts -m ping
[WARNING]: Platform linux on host 3.208.34.116 is using the discovered Python interpreter at /usr/bin/python3.12, but future installation of another Python interpreter could
change the meaning of that path. See https://docs.ansible.com/ansible-core/2.17/reference_appendices/interpreter_discovery.html for more information.
3.208.34.116 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.12"
    },
    "changed": false,
    "ping": "pong"
}
/workspace #
```

Step 5: Handling Host Key Checks

When SSH'ing into a remote server, you might encounter a "host key check" issue.

```
[\W]$ ssh -i ~/Downloads/ansible.pem ec2-user@ec2-35-180-204-130.eu-west-3.compute.amazonaws.com
The authenticity of host 'ec2-35-180-204-130.eu-west-3.compute.amazonaws.com (35.180.204.130)' can't be
stablished.
ECDSA key fingerprint is SHA256:r1afatu8DOg5zCQdrdDpFE8sRh+uJRNKcBudKq6zVS8.
Are you sure you want to continue connecting (yes/no)?
```

There are two ways to handle this:

1. Long-lived servers: Use `ssh-keyscan` to add the server to known_hosts:

   ssh-keyscan -H <your-ec2-ip-address> >> ~/.ssh/known_hosts

2. Ephemeral servers: For automation, disable the host key checking Ansible's configuration file.

   Create the Ansible configuration file: Add a configuration file (`ansible.cfg`) with the following content:

   ```
   touch ansible.cfg

   [defaults]

   host_key_checking = False

   inventory = hosts
   ```

This setting ensures that the host key checking is bypassed for smooth automation.

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/ansible$ ansible servers -i hosts -m ping
The authenticity of host '54.226.174.47 (54.226.174.47)' can't be established.
ED25519 key fingerprint is SHA256:uHpth49nz9aVWEcCXZntVdIM3csQG2L5fRAjoQBf5cE.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
54.226.174.47 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/ansible$ touch ansible.cfg
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/ansible$ ansible servers -i hosts -m ping
54.226.174.47 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
```

Step 6: Basic Ansible Playbook Example

Create Your First Playbook : Inside your `ansible` project directory, create a file named `first_playbook.yml`:

```
touch first_playbook.yml
```

This playbook performs the following tasks on the target servers:

1. **Ensures SSH connectivity** is available before continuing.
2. **Updates the apt package cache** to make sure packages are up to date.
3. **Installs the Nginx web server** package to set up a basic web server.
4. **Starts the Nginx service** and ensures it will run on startup.
5. **Creates an index.html file** with simple content that will be served by Nginx.

```yaml
---
- name: Basic Web Server Setup
  hosts: servers
  gather_facts: False
  become: yes

  tasks:
    - name: Ensure SSH connection is available
      ansible.builtin.wait_for:
        port: 22
        delay: 10
        timeout: 100
        search_regex: OpenSSH
        host: '{{ ansible_host | default(inventory_hostname) }}'
      vars:
        ansible_connection: local
      become: no

    - name: Update apt cache manually
      apt:
        update_cache: yes
        cache_valid_time: 3600

    - name: Install Nginx
      apt:
        name: nginx
        state: present
    - name: Start Nginx service
      service:
        name: nginx
        state: started
        enabled: yes

    - name: Create index.html with "Hello, World!"
      copy:
        dest: /var/www/html/index.html
        content: "Hello from ansible "
        mode: '0644'
```

Copy code :

```
---
- name: Basic Web Server Setup
 hosts: servers
 gather_facts: False
 become: yes

 tasks:
   - name: Ensure SSH connection is available
     ansible.builtin.wait_for:
       port: 22
       delay: 10
       timeout: 100
       search_regex: OpenSSH
       host: '{{ ansible_host | default(inventory_hostname) }}'
     vars:
       ansible_connection: local
     become: no

   - name: Update apt cache manually
     apt:
       update_cache: yes
       cache_valid_time: 3600

   - name: Install Nginx
     apt:
       name: nginx
       state: present
   - name: Start Nginx service
     service:
       name: nginx
       state: started
       enabled: yes

   - name: Create index.html with "Hello, World!"
     copy:
       dest: /var/www/html/index.html
       content: "Hello from ansible "
       mode: '0644'
```

Explanation of Key Components

Play:

- A play is a collection of tasks that will run on a set of hosts. The `name` of the play is a descriptive identifier.

hosts:

- Specifies which hosts or group of hosts (from your inventory file) will be managed by the play.
- Example: `hosts: servers` means this play will run on all hosts in the `servers` group in the hosts file.

become:

- This is used to escalate privileges (like running tasks with `sudo`).
- Example: `become: yes` means the tasks will be run with elevated privileges.

tasks:

- The `tasks` section defines a list of actions that will be executed sequentially on the target hosts.
- Each item under `tasks` is called a **task**.

Task:

- A task is a single action that Ansible performs. Tasks are defined inside the `tasks` list.
- Each task has a `name` (a description of the task), followed by a module.

Example:

```
- name: Install NGINX
  apt:
```

Module:

- A module is a predefined command that Ansible uses to perform specific actions (like installing packages, copying files, or managing services).
- Modules are the building blocks of Ansible tasks.
- Examples of modules: `apt`, `service`, `copy`.
- Example of using the `apt` module to install NGINX:

Subtasks/Parameters:

- Parameters are the options or arguments that you pass to a module to define how the module should behave.
- For example, in the `apt` module, `name: nginx` specifies the package to install, and `state: present` ensures that the package is installed.
- Similarly, in the `copy` module, `content` defines the content of the file, and `dest` specifies the destination file path.

To **run the Ansible playbook**, you use the `ansible-playbook` command. Below, I'll explain how to execute your playbook step by step, including the key options:

`ansible-playbook -i hosts first_playbook.yml`

same for ansible container for windows users
Command Breakdown:

1. ansible-playbook: Executes the playbook.
2. -i hosts: Specifies the inventory file (hosts) that lists target servers.
3. first_playbook.yml: The name of the playbook to run.

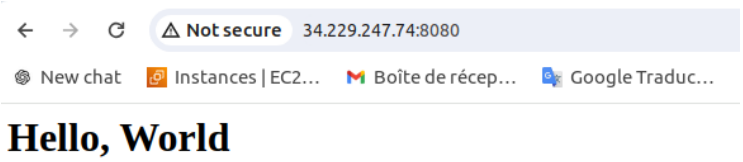
for linux users

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/ansible$ ansible-playbook -i hosts first_playbook.yml

PLAY [Basic Web Server Setup] **************************************************************************************************************************************************

TASK [Ensure SSH connection is available] **************************************************************************************************************************************
ok: [34.229.247.74]

TASK [Update apt cache manually] ***********************************************************************************************************************************************
changed: [34.229.247.74]

TASK [Install Nginx] ***********************************************************************************************************************************************************
changed: [34.229.247.74]

TASK [Start Nginx service] *****************************************************************************************************************************************************
ok: [34.229.247.74]

TASK [Create index.html with "Hello, World!"] **********************************************************************************************************************************
changed: [34.229.247.74]

PLAY RECAP *********************************************************************************************************************************************************************
34.229.247.74              : ok=5    changed=3    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

for windows users

```
/workspace # ansible-playbook -i hosts first_playbook.yml

PLAY [Basic Web Server Setup] **************************************************************************************************************************************************

TASK [Ensure SSH connection is available] **************************************************************************************************************************************
ok: [3.208.34.116]

TASK [Update apt cache manually] ***********************************************************************************************************************************************
changed: [3.208.34.116]

TASK [Install Nginx] ***********************************************************************************************************************************************************
changed: [3.208.34.116]

TASK [Start Nginx service] *****************************************************************************************************************************************************
ok: [3.208.34.116]

TASK [Create index.html with "Hello, World!"] **********************************************************************************************************************************
changed: [3.208.34.116]

PLAY RECAP *********************************************************************************************************************************************************************
3.208.34.116               : ok=5    changed=3    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

/workspace #
```

You can access the web server from a browser using the public IP address of the server. Just open `http://<your-ec2-public-ip>` to see the message "Hello from ansible".



Step 7: Deploying Applications with Ansible

In this step, we will create a new Ansible playbook that will deploy our application using Docker. This playbook will help us automate the process of pulling a Docker image, running the container, and ensuring that our application is up and running on the server.

1. Create a new YAML file named `docker_deploy_playbook.yml` to deploy your application using Docker.
2. Install docker and docker compose:

To eliminate hardcoding of variables, create a file named `ansible-vars.yaml` to store commonly used variables, such as Docker version, application image name, and ports. Here is an example of the variables file:

```
touch ansible-vars.yaml
```

```
# ansible-vars.yaml

docker_service_name: "docker"

cache_time: 3600

docker_package_name: "docker.io"
```

Updated Playbook

Here's the docker_deploy_playbook.yml Ansible playbook that references these variables: (we keep the first tasks that ssh into the instance then we add the bunch of tasks that install docker and docker compose)

Copy code :

```
---

- name: Basic Web Server Setup

 hosts: servers

 gather_facts: False
```

```
  become: yes

  tasks:
    - name: Ensure SSH connection is available
      ansible.builtin.wait_for:
        port: 22
        delay: 10
        timeout: 100
        search_regex: OpenSSH
        host: '{{ ansible_host | default(inventory_hostname) }}'
      vars:
        ansible_connection: local
      become: no


- name: Install Docker and Docker-compose
  hosts: servers
  become: yes
  vars_files:
    - ansible-vars.yaml

  tasks:
    - name: Update apt cache manually
      apt:
        update_cache: yes
        cache_valid_time: "{{ cache_time }}"


    - name: Install Docker
      apt:
        name: "{{ docker_package_name }}"
        update_cache: yes
        state: present
    - name: Install Docker-compose
      apt:
        name: docker-compose
        state: present
    - name: Ensure Docker service is started
      systemd:
        name: "{{ docker_service_name }}"
```

```
    state: started
    enabled: yes
- name: Check Docker version
  command: docker --version
  register: docker_version_output

- name: Display Docker version
  debug:
    msg: "Docker version: {{ docker_version_output.stdout }}"

- name: Check Docker Compose version
  command: docker-compose --version
  register: docker_compose_version_output

- name: Display Docker Compose version
  debug:
    msg: "Docker Compose version: {{ docker_compose_version_output.stdout }}"
```

run the playbook: ansible-playbook -i hosts docker_deploy_playbook.yml

3. Add ubuntu user to docker group:

```
- name: Add ubuntu user to docker group
  user:
    name: ubuntu
    groups: docker
    append: yes

- name: Reconnect to server session
  meta: reset_connection
```

Copy code :

```
- name: Add ubuntu user to docker group
 user:
   name: ubuntu
   groups: docker
   append: yes
```

```
- name: Reconnect to server session
 meta: reset_connection
```

Explanation

Task 1: Add ubuntu user to docker group

This task adds the `ubuntu` user to the `docker` group on the target host .
By adding the user to the `docker` group, the user will have permission to execute Docker commands without using `sudo`. The `append: yes` ensures that existing groups are not overwritten, and only the `docker` group is added.

Task 2: Reconnect to server session

After modifying the user's group membership, Ansible resets the SSH connection to the server using `meta: reset_connection`. This ensures that the updated group membership takes effect immediately for subsequent tasks.

run the playbook: ansible-playbook -i hosts docker_deploy_playbook.yml

Before pushing images to the repo in AWS there is few changes need to be done :

- **Creating the database using AWS Service RDS using FREE TIER**

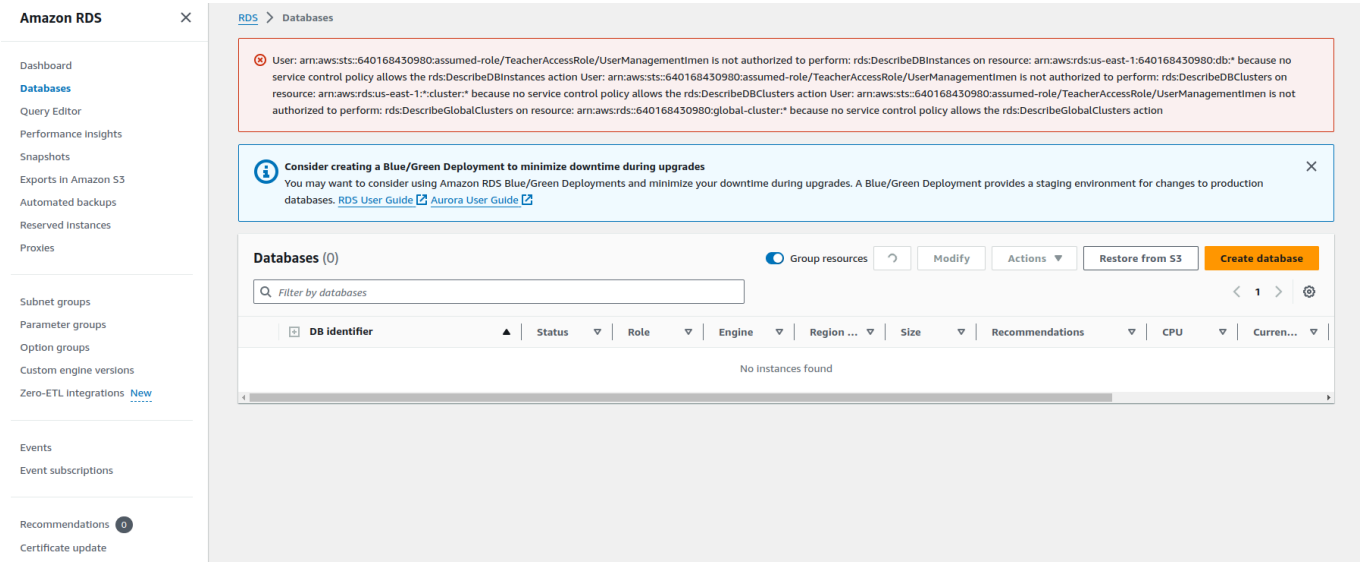
With terraform : add to `main.tf` in my-terraform-project

```
# Create a DB subnet group
resource "aws_db_subnet_group" "mydb_subnet_group" {
 name       = "mydb_subnet_group"
 subnet_ids = [aws_subnet.public_subnet_1.id, aws_subnet.public_subnet_2.id]
 tags = {
   Name = "mydb_subnet_group"
 }
}

# Create an RDS MySQL database instance
resource "aws_db_instance" "mydb" {
 allocated_storage      = 20               # Minimum storage size for MySQL
 engine                 = "mysql"
 engine_version         = "8.0.35"            # Specify the MySQL engine version
```

```
  instance_class          = "db.t3.micro"     # Free-tier eligible instance type

  identifier = "mydb"

  username                = "dbuser"          # Master username

  password                = "DBpassword2024"  # Master password

  db_subnet_group_name    = aws_db_subnet_group.mydb_subnet_group.name

  vpc_security_group_ids = [aws_security_group.web_sg.id]

  publicly_accessible     = true             # Restrict public access

  multi_az                = false             # Single-AZ deployment

  skip_final_snapshot     = true              # Skip snapshot on deletion

  tags = {

    Name = "enis_tp"

  }

}
```

```
terraform apply
```

With aws console



RDS > Create database

Create database Info

Choose a database creation method

- (●) **Standard create**
  You set all of the configuration options, including ones for availability, security, backups, and maintenance.
- ( ) **Easy create**
  Use recommended best-practice configurations. Some configuration options can be changed after the database is created.

Engine options

Engine type Info

- ( ) Aurora (MySQL Compatible)
- ( ) Aurora (PostgreSQL Compatible)
- (●) MySQL
- ( ) MariaDB
- ( ) PostgreSQL
- ( ) Oracle
- ( ) Microsoft SQL Server
- ( ) IBM Db2

Edition

(●) MySQL Community

Engine version Info

View the engine versions that support the following database features.

▼ Hide filters

- [ ] Show only versions that support the Multi-AZ DB cluster Info
  Create a A Multi-AZ DB cluster with one primary DB instance and two readable standby DB instances. Multi-AZ DB clusters provide up to 2x faster transaction commit latency and automatic failover in typically under 35 seconds.
- [ ] Show only versions that support the Amazon RDS Optimized Writes Info
  Amazon RDS Optimized Writes improves write throughput by up to 2x at no additional cost.

Engine version

MySQL 8.0.35

- [ ] Enable RDS Extended Support Info
  Amazon RDS Extended Support is a paid offering. By selecting this option, you consent to being charged for this offering if you are running your database major version past the RDS end of standard support date for that version. Check the end of standard support date for your major version in the RDS for MySQL documentation.

Templates

Choose a sample template to meet your use case.

- ( ) **Production**
  Use defaults for high availability and fast, consistent performance.
- ( ) **Dev/Test**
  This instance is intended for development use outside of a production environment.
- (●) **Free tier**
  Use RDS Free Tier to develop new applications, test existing applications, or gain hands-on experience with Amazon RDS. Info

Deployment options Info
The deployment options below are limited to those supported by the engine you selected above.

- Multi-AZ DB Cluster
  Creates a DB cluster with a primary DB instance and two readable standby DB instances, with each DB instance in a different Availability Zone (AZ). Provides high availability, data redundancy and increases capacity to serve read workloads.
- Multi-AZ DB instance (not supported for Multi-AZ DB cluster snapshot)
  Creates a primary DB instance and a standby DB instance in a different AZ. Provides high availability and data redundancy, but the standby DB instance doesn't support connections for read workloads.
- Single DB instance (not supported for Multi-AZ DB cluster snapshot)
  Creates a single DB instance with no standby DB instances.

Settings

DB instance identifier Info
Type a name for your DB instance. The name must be unique across all DB instances owned by your AWS account in the current AWS Region.

mydb

The DB instance identifier is case-insensitive, but is stored as all lowercase (as in "mydbinstance"). Constraints: 1 to 60 alphanumeric characters or hyphens. First character must be a letter. Can't contain two consecutive hyphens. Can't end with a hyphen.

▼ Credentials Settings

Master username Info
Type a login ID for the master user of your DB instance.

dbuser

1 to 16 alphanumeric characters. The first character must be a letter.

Credentials management
You can use AWS Secrets Manager or manage your master user credentials.

- Managed in AWS Secrets Manager - *most secure*
  RDS generates a password for you and manages it throughout its lifecycle using AWS Secrets Manager.
- Self managed
  Create your own password or have RDS create a password that you manage.

☐ Auto generate password
Amazon RDS can generate a password for you, or you can specify your own password.

Master password Info

••••••••••••••

Password strength Strong

Minimum constraints: At least 8 printable ASCII characters. Can't contain any of the following symbols: / ' " @

Confirm master password Info

••••••••••••••

Instance configuration

The DB instance configuration options below are limited to those supported by the engine that you selected above.

DB instance class Info

▼ Hide filters

Show instance classes that support Amazon RDS Optimized Writes Info
Amazon RDS Optimized Writes improves write throughput by up to 2x at no additional cost.

Include previous generation classes

- Standard classes (includes m classes)
- Memory optimized classes (includes r and x classes)
- Burstable classes (includes t classes)

db.t3.micro
2 vCPUs 1 GiB RAM Network: Up to 2,085 Mbps

Storage

Storage type Info
Provisioned IOPS SSD (io2) storage volumes are now available.

General Purpose SSD (gp3)
Performance scales independently from storage

Allocated storage Info

20 GiB

Minimum: 20 GiB. Maximum: 6,144 GiB

After you modify the storage for a DB instance, the status of the DB instance will be in storage-optimization. Your instance will remain available as the storage-optimization operation completes. Learn more

▶ Advanced settings
Baseline IOPS of 3,000 IOPS and storage throughput of 125 MiBps are included for allocated storage less than 400 GiB.

▶ Storage autoscaling

▶ Storage autoscaling

Connectivity Info

Compute resource
Choose whether to set up a connection to a compute resource for this database. Setting up a connection will automatically change connectivity settings so that the compute resource can connect to this database.

- (•) Don't connect to an EC2 compute resource
  Don't set up a connection to a compute resource for this database. You can manually set up a connection to a compute resource later.
- ( ) Connect to an EC2 compute resource
  Set up a connection to an EC2 compute resource for this database.

Virtual private cloud (VPC) Info
Choose the VPC. The VPC defines the virtual networking environment for this DB instance.

tp_cloud_devops_vpc (vpc-09dbb252bddeabdce)
2 Subnets, 2 Availability Zones

Only VPCs with a corresponding DB subnet group are listed.

ⓘ After a database is created, you can't change its VPC.

DB subnet group Info
Choose the DB subnet group. The DB subnet group defines which subnets and IP ranges the DB instance can use in the VPC that you selected.

Create new DB Subnet Group

Public access Info

- (•) Yes
  RDS assigns a public IP address to the database. Amazon EC2 instances and other resources outside of the VPC can connect to your database. Resources inside the VPC can also connect to the database. Choose one or more VPC security groups that specify which resources can connect to the database.
- ( ) No
  RDS doesn't assign a public IP address to the database. Only Amazon EC2 instances and other resources inside the VPC can connect to your database. Choose one or more VPC security groups that specify which resources can connect to the database.

VPC security group (firewall) Info
Choose one or more VPC security groups to allow access to your database. Make sure that the security group rules allow the appropriate incoming traffic.

- (•) Choose existing
  Choose existing VPC security groups
- ( ) Create new
  Create new VPC security group

Existing VPC security groups

Choose one or more options

web-server-sg ✕

Availability Zone Info

No preference

RDS Proxy
RDS Proxy is a fully managed, highly available database proxy that improves application scalability, resiliency, and security.

- [ ] Create an RDS Proxy Info
  RDS automatically creates an IAM role and a Secrets Manager secret for the proxy. RDS Proxy has additional costs. For more information, see Amazon RDS Proxy pricing.

Certificate authority - *optional* Info
Using a server certificate provides an extra layer of security by validating that the connection is being made to an Amazon database. It does so by checking the server certificate that is automatically installed on all databases that you provision.

rds-ca-rsa2048-g1 (default)
Expiry: May 26, 2061

If you don't select a certificate authority, RDS chooses one for you.

▶ Additional configuration

Tags - *optional*

A tag consists of a case-sensitive key-value pair.

No tags associated with the resource.

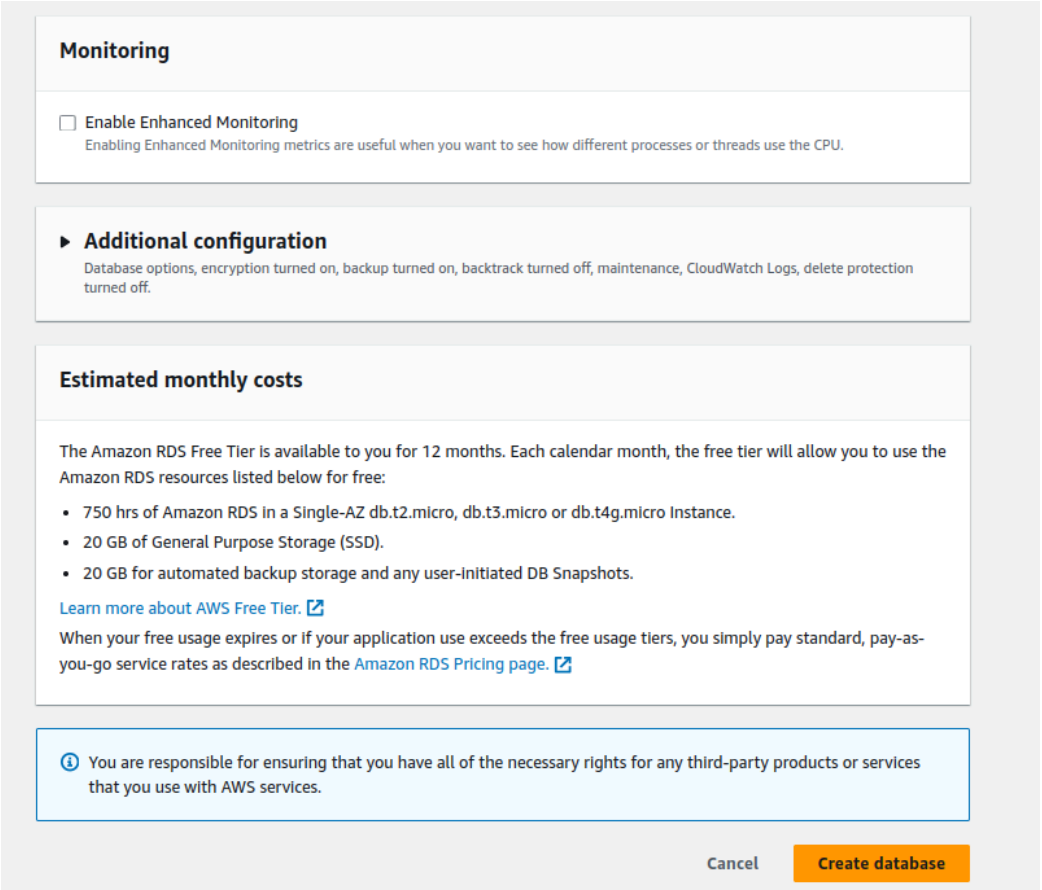
Add new tag

You can add up to 50 more tags.

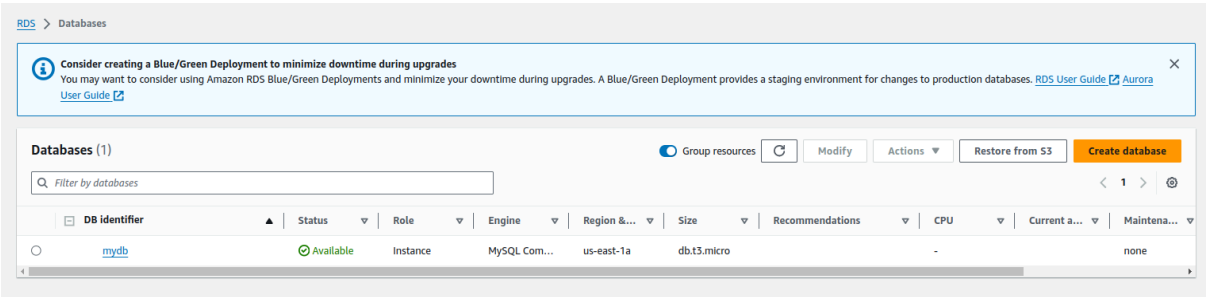
Database authentication

Database authentication options Info

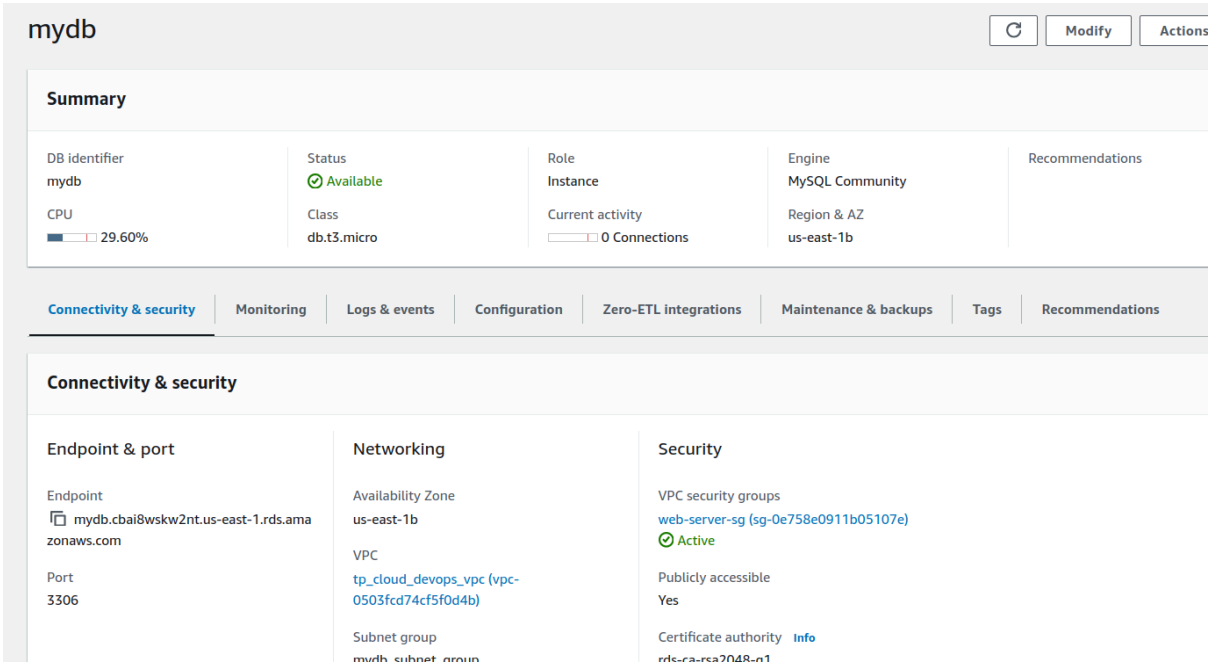
- (•) Password authentication
  Authenticates using database passwords.
- ( ) Password and IAM database authentication
  Authenticates using the database password and user credentials through AWS IAM users and roles.
- ( ) Password and Kerberos authentication
  Choose a directory in which you want to allow authorized users to authenticate with this DB instance using Kerberos Authentication.



Ensure you reach finally to that configuration with no additional cost



After creating the database, please wait a few minutes for the database status to change to **Available**. Once the status is Available, click on the database name to open its details page. Navigate to the **Connectivity & security tab,** where you'll find the **Endpoint and Port** for accessing the database.



4. Changes in backend and frontend before build:

go to settings.py in the django project and change the database section:

```
DATABASES = {
     'default': {
         'ENGINE': 'django.db.backends.mysql',
         'NAME': ‘enis_tp’,
         'USER': 'dbuser',
         'PASSWORD': 'DBpassword2024',
         'HOST': 'endpoint of rds ',
         'PORT': 3306,
     }
}
```

You need to open the port 3306 of the database in the associated security group , Go back to terraform project and add this portion of code that allows inbound traffic on port 3306

 # Allow inbound RDS traffic (e.g., MySQL on port 3306)

```
resource "aws_security_group_rule" "allow_rds_inbound" {
  type              = "ingress"
  security_group_id = aws_security_group.web_sg.id
```

```
  from_port         = 3306                    # Change this to match your
database port

  to_port           = 3306                    # Same as above

  protocol          = "tcp"

  cidr_blocks       = ["0.0.0.0/0"]           # For production, replace
this with a specific IP or CIDR block

}
```

 # Allow inbound to backend on port 8000

```
resource "aws_security_group_rule" "allow_backend_inbound" {

  type              = "ingress"

  security_group_id = aws_security_group.web_sg.id

  from_port         = 8000

  to_port           = 8000                  # Same as above

  protocol          = "tcp"

  cidr_blocks       = ["0.0.0.0/0"]           # For production, replace
this with a specific IP or CIDR block

}
```

 # Allow inbound HTTP traffic on port 81 to access the final application

```
resource "aws_security_group_rule" "allow_web_http_inbound-81" {

 type              = "ingress"

 security_group_id = aws_security_group.web_sg.id

 from_port         = 81

 to_port           = 81

 protocol          = "tcp"

 cidr_blocks       = ["0.0.0.0/0"]

}
```

Run terraform apply

Now connect on the db to create the enis_tp DB inside the rds

```
mysql -h rds-endpoint -P 3306 -u dbuser -p
```

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/Downloads$ mysql -h mydb.cxuo68eem91h.us-east-1.rds.amazonaws.com -P 3306 -u dbuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 34
Server version: 8.0.35 Source distribution

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

You'll be prompted for the password. Enter `DBpassword2024`

Create the Database: `CREATE DATABASE enis_tp;`

Check if the Database Exists : `SHOW DATABASES;`

Exit the MySQL Shell: Once done, exit the MySQL shell with: `EXIT;`

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/Downloads$ mysql -h mydb.cxuo68eem91h.us-east-1.rds.amazonaws.com -P 3306 -u dbuse
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 34
Server version: 8.0.35 Source distribution

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> CREATE DATABASE enis_tp;
Query OK, 1 row affected (0.11 sec)

mysql> SHOW DATABASES;
+--------------------+
| Database           |
+--------------------+
| enis_tp            |
| information_schema |
| mysql              |
| performance_schema |
| sys                |
+--------------------+
5 rows in set (0.10 sec)

mysql> EXIT;
Bye
```

Then you can rebuild the backend app

2. go to the react app and change this in api.js and change

```
const api : AxiosInstance = axios.create({
  baseURL: "http://localhost:8000"
});
```

by the ip address of the ec2 instance

```
const api : AxiosInstance = axios.create({
  baseURL: "http://34.229.247.74:8000"
});
```

Then you can rebuild the frontend app

5. Manually Build and Push Backend and Frontend Docker Images to AWS ECR

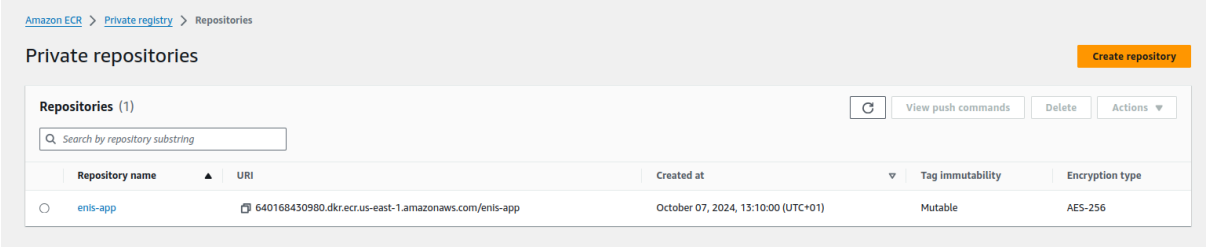
Step 1: What is AWS ECR (Elastic Container Registry)?

Amazon Elastic Container Registry (ECR) is a fully managed Docker container registry provided by AWS that allows you to store, manage, and deploy container images. It integrates with Amazon ECS, EKS, and other AWS services, providing a secure and scalable storage for container images. You can push Docker images to ECR and pull them to AWS services or other environments when needed.

Step 2: Create an ECR Repository in AWS

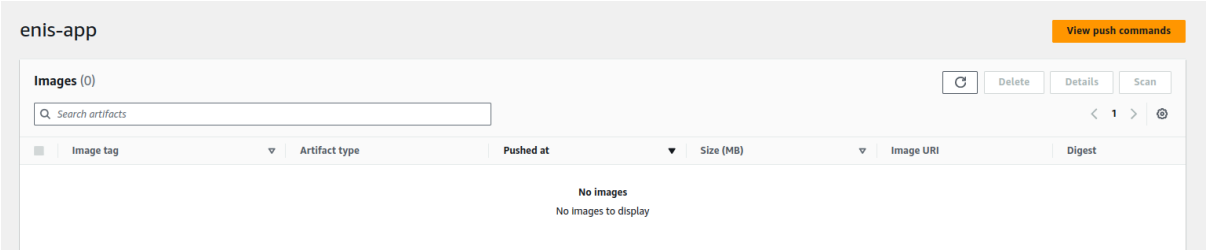
Before you can push Docker images, you must create a repository in AWS ECR to store your backend and frontend images.

1. **Log in to the AWS Management Console**:
   - Go to the Amazon ECR Console.
2. **Create a Repository**:
   - Navigate to **Amazon ECR > Repositories**.
   - Click on **Create repository**.
   - Name the repository `enis-app` (you can use any name you prefer).
   - Choose **Visibility**: Private (by default).
   - Click **Create repository** to finalize the setup.
3. Now, you have an ECR repository ready to receive your Docker images.



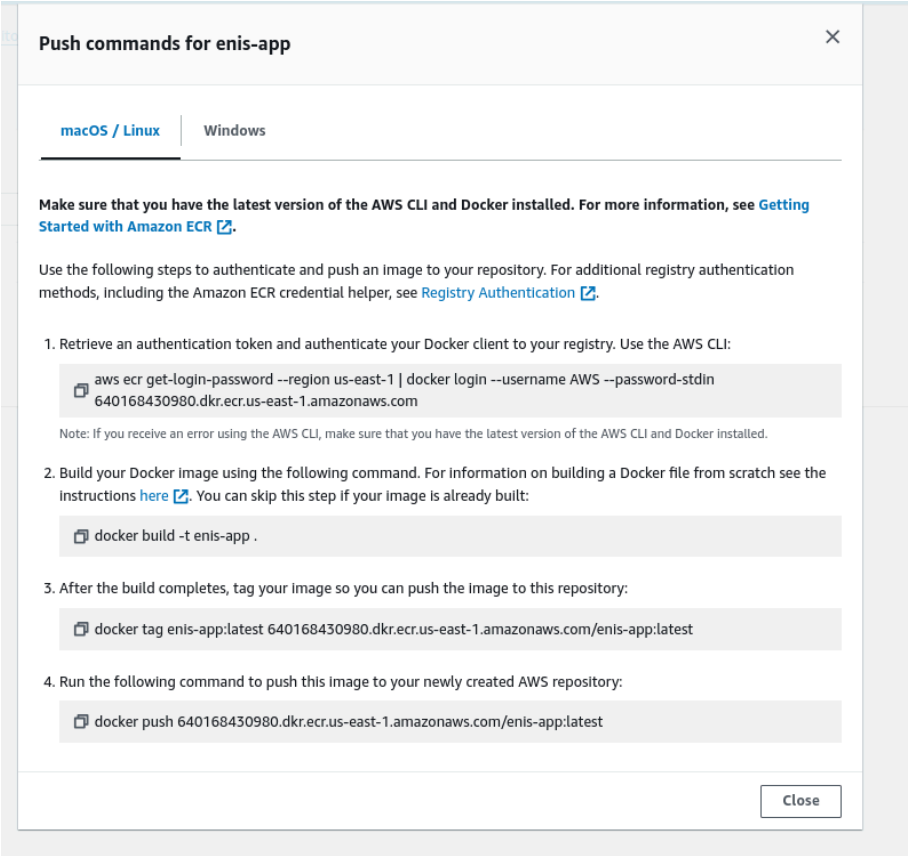
Step 3: Build and Push Frontend Image to ECR

Commands to Build and Push the Frontend Docker Image



Click on View push commands and follow

we will need just log in , tag and push the images since they are already built



1. Give Docker Access to Your User:

   sudo usermod -aG docker $USER

   sudo chmod 666 /var/run/docker.sock

2. Login to AWS ECR:

   aws ecr get-login-password --region us-east-1 | docker login --username AWS --password-stdin 746200881003.dkr.ecr.us-east-1.amazonaws.com

   This command logs you into your AWS ECR repository by using the AWS CLI to retrieve your login credentials.

   Replace `746200881003.dkr.ecr.us-east-1.amazonaws.com` with **your ECR URL.**

3. Tag the Frontend Image:

docker tag frontend:latest 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:frontend-1.0

`docker tag` assigns the image to the ECR repository with a specific name and version.

`frontend:latest` is the local image you're tagging.

`640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:frontend-app-1.0` is the full path of the repository in ECR

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/enis-app-tp/frontend$ docker tag backend:latest 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:backend-1.0
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/enis-app-tp/frontend$ docker images
REPOSITORY                                                  TAG               IMAGE ID       CREATED          SIZE
640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app       frontend-1.0      02d3d9dbf1dd   16 minutes ago   43.4MB
frontend                                                    latest            02d3d9dbf1dd   16 minutes ago   43.4MB
<none>                                                      <none>            15646fe2696b   16 minutes ago   728MB
640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app       backend-1.0       e8a975c57f0e   21 minutes ago   295MB
```

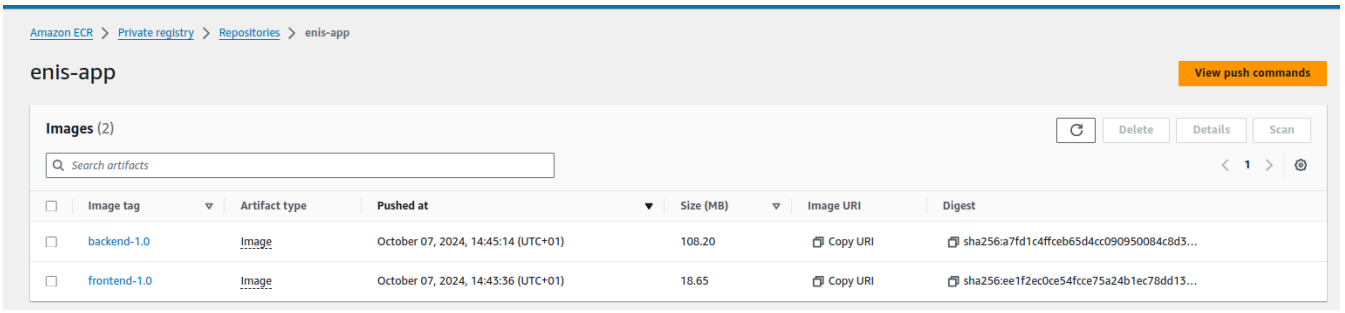
4. Push the Frontend Image to ECR:

docker push 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:frontend-1.0

docker push 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:backend-1.0

```
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/enis-app-tp/frontend$ docker push 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:frontend-1.0
The push refers to repository [640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app]
e28aadd394cf: Pushed
b0f60355fd52: Pushed
027907faf592: Pushed
11134cc97d7f: Pushed
f7a5847cdca9: Pushed
aec1e8cf14f5: Pushed
717b3a077b07: Pushed
2ff96b2e5450: Pushed
63ca1fbb43ae: Pushed
frontend-1.0: digest: sha256:ee1f2ec0ce54fcce75a24b1ec78dd132477b96b94841b37f5aef401f207db7e8 size: 2198
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/enis-app-tp/frontend$ docker push 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:backend-1.0
The push refers to repository [640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app]
4a662fda027d: Pushed
8c16490b08d9: Pushed
58783f9e10fd: Pushed
90034b501a11: Pushed
6f65de0d2cde: Pushed
7bbf9f88fb23: Pushed
c5321f7f53ff: Pushed
df6c1b185b95: Pushed
b23fedba7dbd: Pushed
ae2d55769c5e: Pushed
e2ef8a51359d: Pushed
backend-1.0: digest: sha256:a7fd1c4ffceb65d4cc090950084c8d3f845836ac802e8003fc29b0d44236f3fb size: 2625
imen@imen-ASUS-TUF-Dash-F15-FX517ZC-FX517ZC:~/tp enis/enis-app-tp/frontend$
```

Verify that the images exist in the ECR



6. Install AWS CLI on the remote machine

```
- name: Install AWS CLI on EC2 Instances
 hosts: servers
 become: yes
 tasks:
   - name: Ensure curl is installed
     package:
       name: curl
       state: present

   - name: Ensure unzip is installed
     package:
       name: unzip
       state: present

   - name: Check if AWS CLI is installed
     command: "aws --version"
     register: aws_cli_check
     ignore_errors: true

   - name: Download AWS CLI installation script using curl
     command: curl -o /tmp/awscliv2.zip https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip
     when: aws_cli_check.failed

   - name: Unzip AWS CLI installation package
     unarchive:
       src: "/tmp/awscliv2.zip"
       dest: "/tmp/"
       remote_src: yes
     when: aws_cli_check.failed

   - name: Run AWS CLI installer
```

```
    command: "/tmp/aws/install -i /usr/local/aws-cli -b /usr/local/bin --update"
    when: aws_cli_check.failed
  - name: Verify AWS CLI installation
    command: "aws --version"
    register: aws_cli_version
  - debug:
      msg: "AWS CLI version: {{ aws_cli_version.stdout }}"
```

7. Pull images from the AWS ECR to our remote server (ec2)

```yaml
- name: Pull Docker image for the frontend from ECR to EC2 instance
  hosts: servers
  become: yes
  vars_files:
    - ansible-vars.yaml

  tasks:
    - name: Log in to Amazon ECR
      docker_login:
        registry_url: "{{ ecr_url }}"
        username: AWS
        password: "{{ lookup('pipe', 'aws ecr get-login-password --region ' + region) }}"
        reauthorize: yes

    - name: Pull frontend Docker image from ECR
      docker_image:
        name: "{{ ecr_url }}/{{ ecr_repository }}"
        tag: "{{ frontend_image_tag }}"
        source: pull

    - name: Pull backend Docker image from ECR
      docker_image:
        name: "{{ ecr_url }}/{{ ecr_repository }}"
        tag: "{{ backend_image_tag }}"
        source: pull
```

Copy code:

```
- name: Pull Docker image for the frontend from ECR to EC2 instance
  hosts: servers
  become: yes
  vars_files:
    - ansible-vars.yaml


  tasks:
    - name: Log in to Amazon ECR
```

```
    docker_login:
      registry_url: "{{ ecr_url }}"
      username: AWS
      password: "{{ lookup('pipe', 'aws ecr get-login-password --region ' + region) }}"
      reauthorize: yes

  - name: Pull frontend Docker image from ECR
    docker_image:
      name: "{{ ecr_url }}/{{ ecr_repository }}"
      tag: "{{ frontend_image_tag }}"
      source: pull

  - name: Pull backend Docker image from ECR
    docker_image:
      name: "{{ ecr_url }}/{{ ecr_repository }}"
      tag: "{{ backend_image_tag }}"
      source: pull
  - name: Display Docker images on the host
    command: docker images
    register: docker_images_output
  - name: Show Docker images
    debug:
      msg: "{{ docker_images_output.stdout }}"
```

Updated file ansible-vars.yaml

```
# ecr-vars.yaml
ecr_url: "ecr url"
ecr_repository: "enis-app"
region: "us-east-1"
frontend_image_tag: "frontend-1.0"
backend_image_tag: "backend-1.0"
```

8. Start the containers with docker compose

Updated `docker-compose.yaml` for Server

Here's an updated version of the `docker-compose.yaml` file .
This new configuration is optimized to run on the server, with the `mysql` service removed and the backend's dependency on it eliminated. The updated file

references the correct images in Amazon ECR and configures health checks for the `backend-app` and `frontend-app`.

Change the images names based on the images names inside the server pulled from ecr including the tag

```
version: '3.8'

services:

 backend-app:

   image: 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:backend-1.0  # Use the already pulled image

   container_name: backend-app

   restart: always

   ports:

     - "8000:8000"

   networks:

     - my_bridge

   healthcheck:

     test: ["CMD-SHELL", "curl -f http://localhost:8000/admin/login/?next=/admin/ || exit 1"]

     interval: 30s

     timeout: 10s

     retries: 5


 frontend-app:

   image: 640168430980.dkr.ecr.us-east-1.amazonaws.com/enis-app:frontend-1.0  # Use the already built image

   container_name: frontend-app

   restart: always

   ports:

     - "81:80"

   networks:

     - my_bridge

   healthcheck:

     test: ["CMD-SHELL", "curl -f http://localhost || exit 1"]

     interval: 30s

     timeout: 10s

     retries: 3


networks:

 my_bridge:

   external: true
```

Explanation of Changes

- Removed MySQL Service: Since the server now connects directly to an external MySQL database, the `mysql` service, its environment variables, and its volume have been removed.
- Backend and Frontend Images: Both `backend-app` and `frontend-app` now use images pulled from ECR, specified with the complete ECR repository path.
- Dependencies:
    - `frontend-app` depends only on `backend-app` and will wait for the backend to be healthy before starting.
- Health Checks:
    - `backend-app`: Checks the Django admin login page to confirm the service is healthy.
    - `frontend-app`: won't check on backend because there are no migrations applied yet so it would report either way unhealthy

Now we should put that file inside the ansible directory and copy it inside the ec2 instance to be able to execute it there and run the containers , but first create the network my_bridge

Updated playbook : add this set of tasks

```
- name: Start Docker containers

 hosts: servers

 become: yes

 vars_files:

   - ansible-vars.yaml

 tasks:

   - name: Create Docker Network

     docker_network:

       name: "{{ docker_network_name }}"

       state: present

   - name: Copy Docker Compose file to the EC2 instance

     copy:

       src: "{{ compose_local_path }}"

       dest: "{{ compose_remote_path }}"

   - name: Start Docker containers from Docker Compose

     docker_compose:

       project_src: "{{ project_src_path }}"
```

```
      state: present  # "present" is equivalent to "docker-compose up", "absent" would stop the containers.

  - name: Run makemigrations inside backend container

    command: docker exec {{ backend_container_name }} python manage.py makemigrations

  - name: Run migrate inside backend container

    command: docker exec {{ backend_container_name }} python manage.py migrate
```

Updated file ansible-vars.yaml (for linux users)

```
# docker variables

docker_network_name: "my_bridge"

compose_local_path: "/home/imen/tp enis/ansible/docker-compose.yaml" #replace with your local path of the
updated file

compose_remote_path: "/home/ubuntu/docker-compose.yaml"

project_src_path: "/home/ubuntu"

backend_container_name: "backend-app"
```

For windows users who are using ansible container ;

the compose local path should be the path inside the container which is normally : /workspace/docker-compose.yaml

Updated file ansible-vars.yaml (for windows users)

```
# docker variables

docker_network_name: "my_bridge"

compose_local_path: "/workspace/docker-compose.yaml" #replace with your local path of the updated file

compose_remote_path: "/home/ubuntu/docker-compose.yaml"

project_src_path: "/home/ubuntu"

backend_container_name: "backend-app"
```

Explanation:

- Name: `Copy docker compose to my ec2 instance`
  This task copies the `docker-compose.yaml` file from your local machine (where you're running Ansible) to the target EC2 instance.Make sure the local path to the file is correct in the variables file.
- `copy` Module:
  - `src`: Specifies the source path on your local machine where the `docker-compose.yaml` file is located.
  - `dest`: Specifies the destination path on the EC2 instance where the file will be copied. Here, it is copied to `/home/ubuntu`, which is a directory on the target EC2 instance.

    - The `docker-compose.yaml` file defines the services, networks, and volumes for your multi-container Docker application. It needs to be present on the EC2 instance to run `docker-compose` and start the containers.
    - This step ensures that the configuration file is available on the EC2 instance before executing the `docker-compose up` command.
- Name: `start docker containers from compose`
  This task runs `docker-compose up` on the EC2 instance to start the Docker containers defined in the `docker-compose.yaml` file.
- `docker_compose` Module:
    - `project_src`: Specifies the directory where the `docker-compose.yaml` file is located on the EC2 instance. In this case, it's `/home/ubuntu`, where the file was copied in the previous step.
    - `state`:
        - `present`: This is equivalent to running `docker-compose up`. It starts the containers defined in the `docker-compose.yaml` file. If the containers are already running, they will be left as is.
        - `absent`: If used instead, it would stop and remove the containers (equivalent to `docker-compose down`).

Run makemigrations and migrate inside backend container

Our backend container is set up to connect to the RDS instance, but the necessary database tables aren't automatically generated. After the backend container starts up via Docker Compose, we need to enter the container and run `makemigrations` and `migrate`, just as we did manually in the Docker session. This will create the tables in the RDS database. Once the migrations are applied, we can create a superuser, allowing us to log in to the hosted app with admin access.

To create a superuser in Django within the backend container, you can add a task that runs a Django management command for superuser creation. This command will use environment variables for the username, email, and password to automate the process.

Here's how you can add this task to your playbook:

1. Update `ansible-vars.yaml`: Define environment variables for the superuser's details in your variables file.

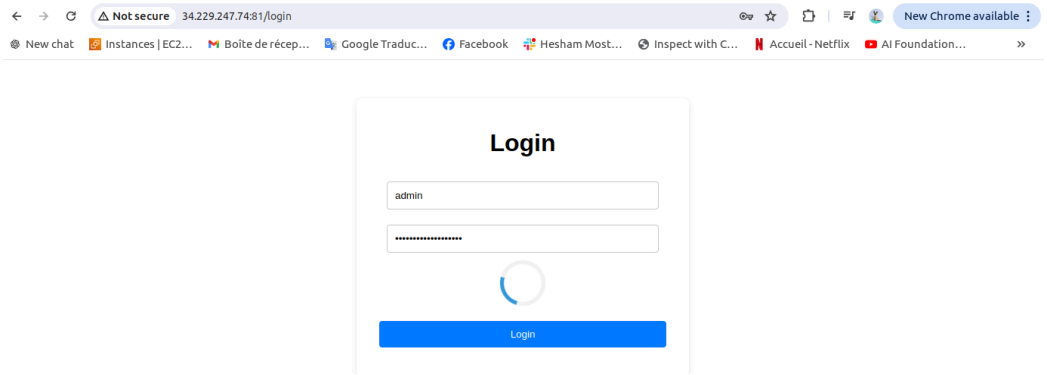
```
# app credentials

superuser_username: "admin"
```

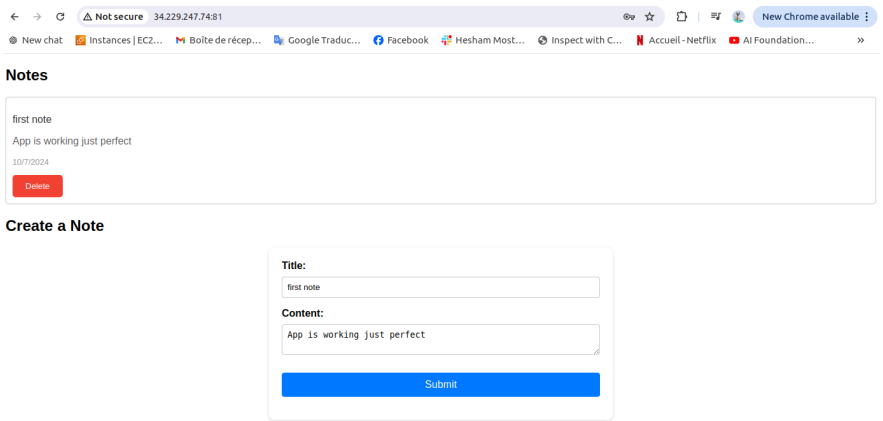
```
superuser_email: "admin@example.com"

superuser_password: "SuperSecretPassword"
```

Add the Superuser Creation Task: In your playbook, add a task to run the Django command for superuser creation. This uses a one-time command to create the superuser if it doesn't already exist.

```
- name: Create superuser inside backend container

 command: >

   docker exec {{ backend_container_name }} python manage.py shell -c

   "from django.contrib.auth import get_user_model;

   User = get_user_model();

   User.objects.filter(username='{{ superuser_username }}').exists() or

   User.objects.create_superuser('{{ superuser_username }}', '{{ superuser_email }}', '{{ superuser_password }}')"
```

Finally run the playbook and try to access the app on http://<your-ec2-instance-public-ip>:81 and try to connect with the credentials set in the ansible-vars file





After you've ensured that the application is working perfectly and all migrations are applied successfully, it's essential to clean up any resources you've provisioned to avoid unnecessary costs.

1. Destroy Terraform Resources: Run the following command to delete the infrastructure created by Terraform: `terraform destroy`
2. Terminate RDS Instances (if RDS wasn't managed by Terraform): If your RDS instance was created outside of Terraform, you'll need to terminate it separately:
    - Go to the AWS RDS Console.
    - Select your RDS instance and choose Actions > Delete.
    - be sure to **uncheck** the option to create a final snapshot before deletion. This avoids additional storage costs for the snapshot.