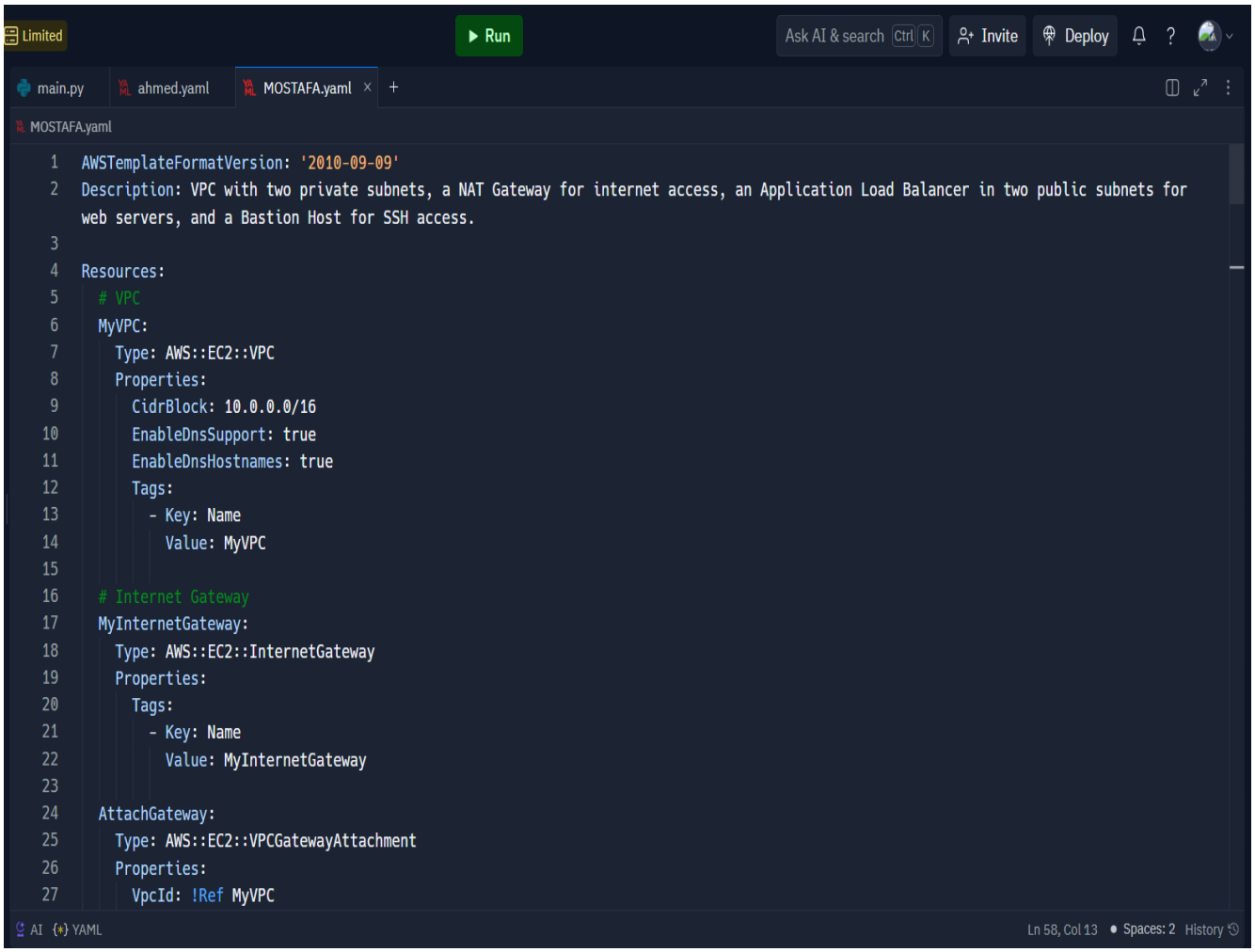
Final Project Documentation:

1. Create Network Environment with Infrastructure as Code (IaC)

Use AWS Cloud Formation or Terraform to define and manage our network infrastructure programmatically.

Use version control for IaC templates, segment our network using Subnets, and secure access with Security Groups and Network ACLs. Deploy a NAT Gateway to allow private instances internet access without exposing them to the public.



main.py | ahmed.yaml | MOSTAFA.yaml

MOSTAFA.yaml

```yaml
    VpcId: !Ref MyVPC
    InternetGatewayId: !Ref MyInternetGateway

# NAT Gateway
NatEIP:
  Type: AWS::EC2::EIP
  Properties:
    Domain: vpc

MyNatGateway:
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt NatEIP.AllocationId
    SubnetId: !Ref PublicSubnet1
    Tags:
      - Key: Name
        Value: MyNatGateway

# Route Tables
PublicRouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref MyVPC
    Tags:
      - Key: Name
        Value: PublicRouteTable

PrivateRouteTable:
```

main.py | MOSTAFA.yaml

MOSTAFA.yaml

```yaml
PrivateRouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref MyVPC
    Tags:         - Key: Name
        Value: PrivateRouteTable

# Public Route
PublicRoute:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PublicRouteTable
    DestinationCidrBlock: 0.0.0.0/0
    GatewayId: !Ref MyInternetGateway

# Private Route
PrivateRoute:
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref MyNatGateway

# Subnets
PublicSubnet1:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref MyVPC
```

AI {•} YAML Ln 54, Col 21 • Spaces: 2 History

main.py MOSTAFA.yaml

MOSTAFA.yaml

```yaml
    Properties:
      VpcId: !Ref MyVPC
      CidrBlock: 10.0.1.0/24
      AvailabilityZone: us-east-1a
      MapPublicIpOnLaunch: true
      Tags:
        - Key: Name
          Value: PublicSubnet1

  PublicSubnet2:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref MyVPC
      CidrBlock: 10.0.2.0/24
      AvailabilityZone: us-east-1b
      MapPublicIpOnLaunch: true
      Tags:
        - Key: Name
          Value: PublicSubnet2

  PrivateSubnet1:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref MyVPC
      CidrBlock: 10.0.3.0/24
      AvailabilityZone: us-east-1a
      MapPublicIpOnLaunch: false
      Tags:
```

main.py MOSTAFA.yaml

MOSTAFA.yaml

```yaml
      Tags:
        - Key: Name
          Value: PrivateSubnet1

  PrivateSubnet2:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref MyVPC
      CidrBlock: 10.0.4.0/24
      AvailabilityZone: us-east-1b
      MapPublicIpOnLaunch: false
      Tags:
        - Key: Name
          Value: PrivateSubnet2

  PublicSubnet1RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PublicSubnet1
      RouteTableId: !Ref PublicRouteTable

  PublicSubnet2RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PublicSubnet2
      RouteTableId: !Ref PublicRouteTable

  PrivateSubnet1RouteTableAssociation:
```

AI {+} YAML Ln 134, Col 39 Spaces: 2 History

main.py | MOSTAFA.yaml

MOSTAFA.yaml

```yaml
  PrivateSubnet1RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PrivateSubnet1
      RouteTableId: !Ref PrivateRouteTable

  PrivateSubnet2RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PrivateSubnet2
      RouteTableId: !Ref PrivateRouteTable

  # Security Group for Bastion Host
  BastionSecurityGroup:
    Type: AWS::EC2::SecurityGroup
    Properties:
      GroupDescription: Allow SSH from anywhere
      VpcId: !Ref MyVPC
      SecurityGroupIngress:
        - IpProtocol: tcp
          FromPort: 22
          ToPort: 22
          CidrIp: 0.0.0.0/0  # Limit this to a specific IP for security

  # Bastion EC2 Instance (in Public Subnet)
  BastionHost:
    Type: AWS::EC2::Instance
    Properties:
```

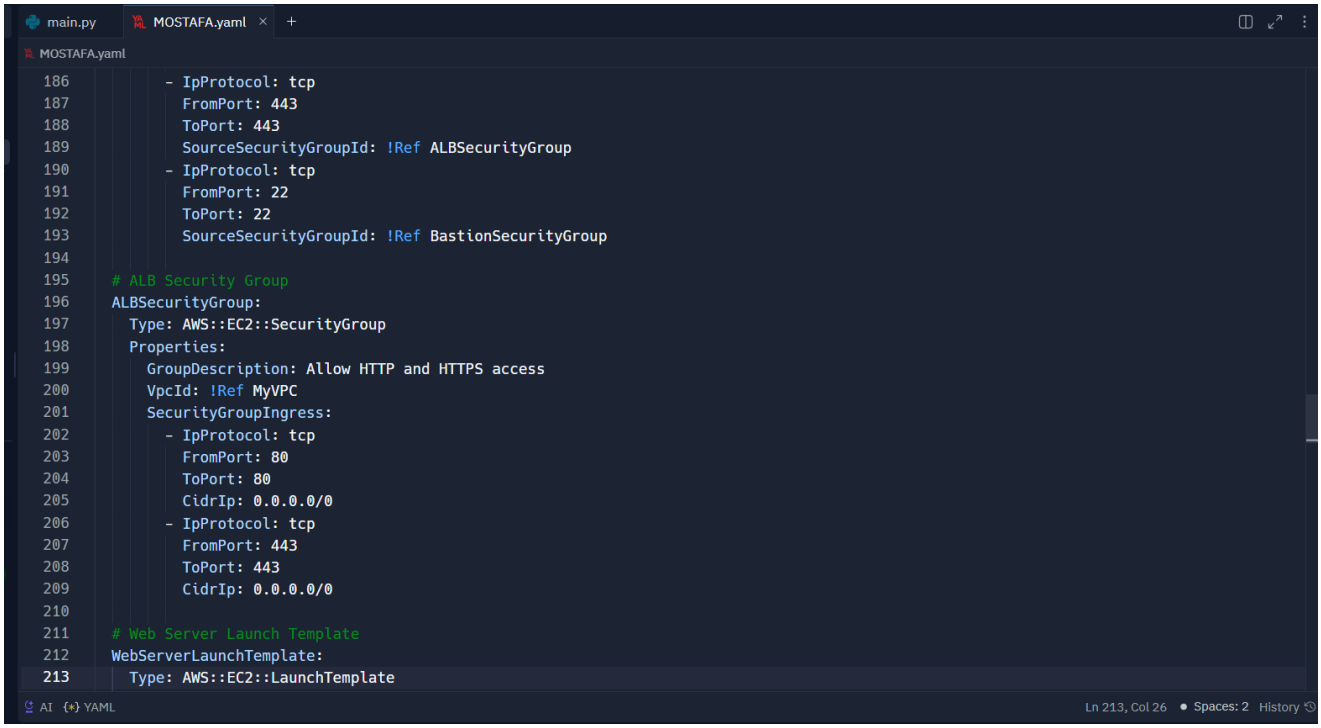
AI {•} YAML — Ln 161, Col 16 • Spaces: 2 History

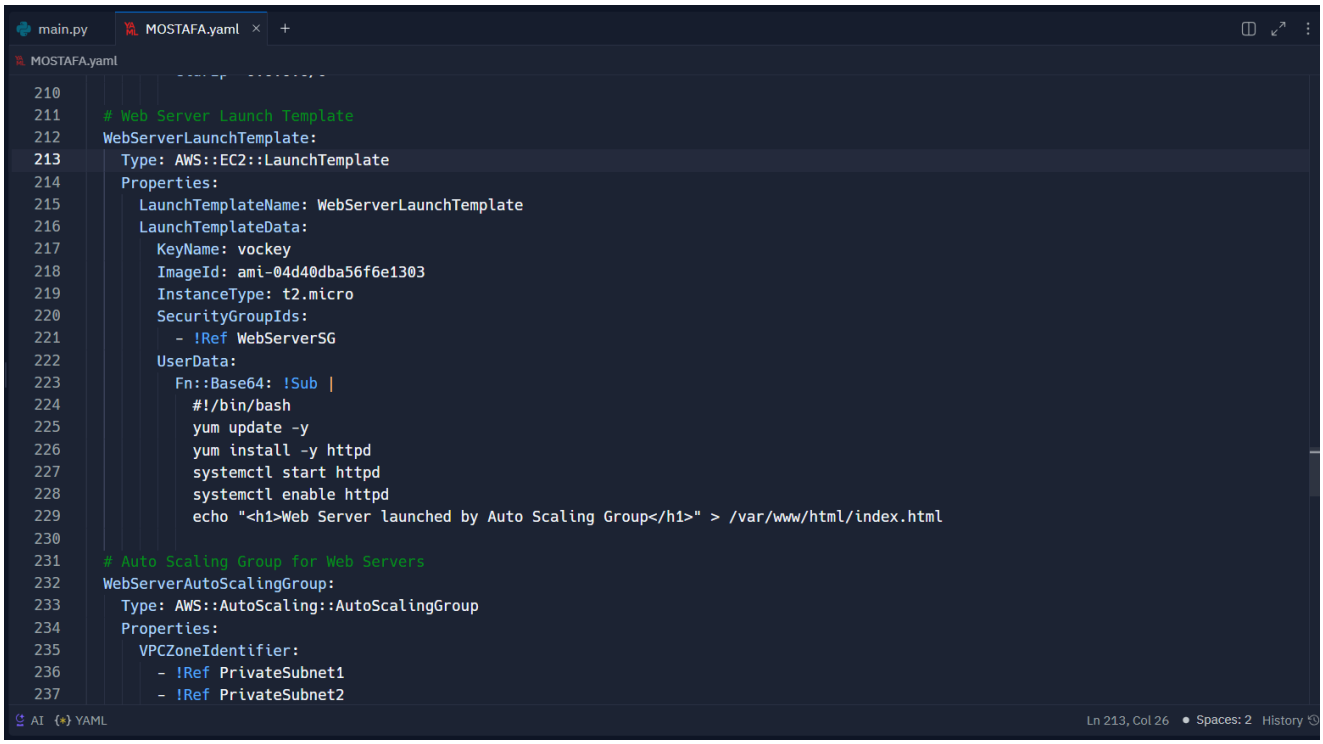
main.py | MOSTAFA.yaml

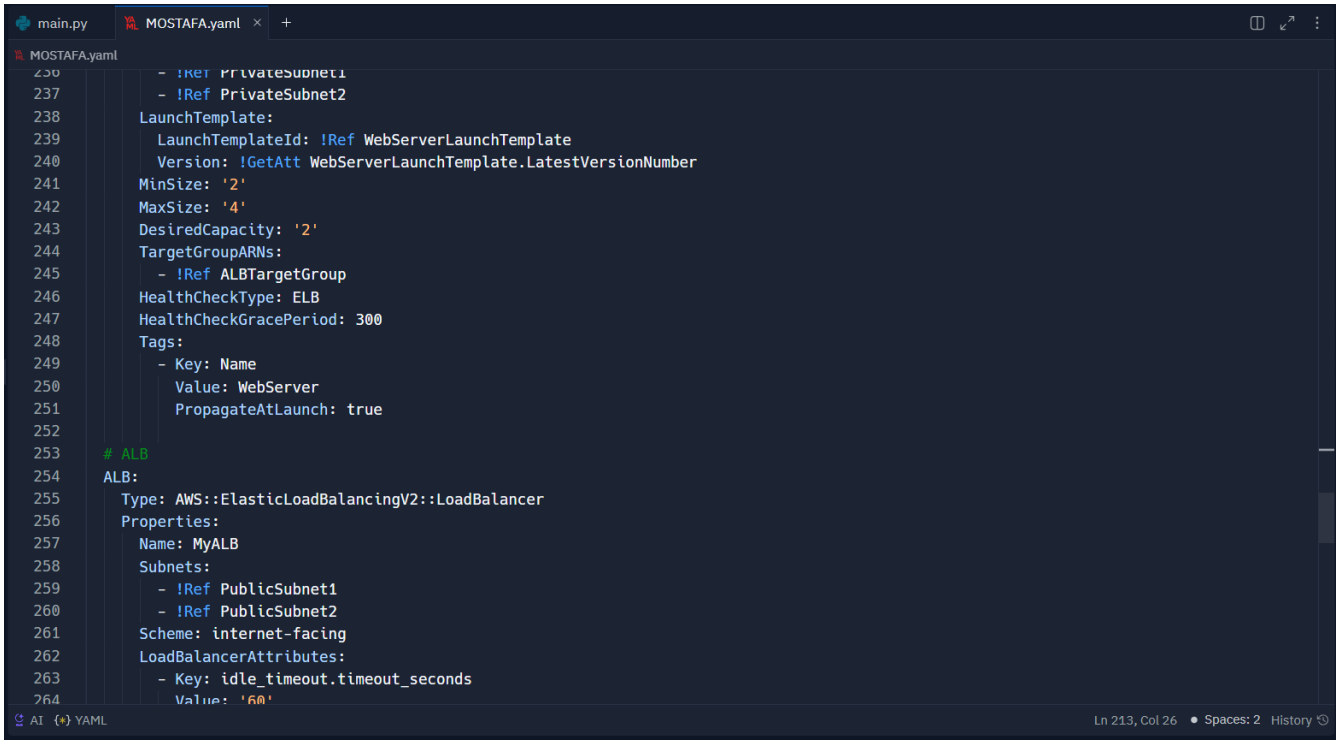
MOSTAFA.yaml

```yaml
  BastionHost:
    Type: AWS::EC2::Instance
    Properties:
      InstanceType: t2.micro
      KeyName: vockey  # Replace with your KeyPair name
      ImageId: ami-04d40dba56f6e1303  # Replace with the latest Amazon Linux AMI for your region
      NetworkInterfaces:
        - AssociatePublicIpAddress: true
          DeviceIndex: 0
          SubnetId: !Ref PublicSubnet1
          GroupSet:
            - !Ref BastionSecurityGroup
      Tags:
        - Key: Name
          Value: BastionHost

  # Security Group for Web Servers (allow SSH from Bastion Host)
  WebServerSG:
    Type: AWS::EC2::SecurityGroup
    Properties:
      GroupDescription: Allow HTTP, HTTPS, and SSH from Bastion
      VpcId: !Ref MyVPC
      SecurityGroupIngress:
        - IpProtocol: tcp
          FromPort: 80
          ToPort: 80
          SourceSecurityGroupId: !Ref ALBSecurityGroup
        - IpProtocol: tcp
```

AI {•} YAML — Ln 186, Col 26 • Spaces: 2 History


main.py
MOSTAFA.yaml
MOSTAFA.yaml
- IpProtocol: tcp
FromPort: 443
ToPort: 443
SourceSecurityGroupId: !Ref ALBSecurityGroup
- IpProtocol: tcp
FromPort: 22
ToPort: 22
SourceSecurityGroupId: !Ref BastionSecurityGroup
ALB Security Group
ALBSecurityGroup:
Type: AWS::EC2::SecurityGroup
Properties:
GroupDescription: Allow HTTP and HTTPS access
VpcId: !Ref MyVPC
SecurityGroupIngress:
- IpProtocol: tcp
FromPort: 80
ToPort: 80
CidrIp: 0.0.0.0/0
- IpProtocol: tcp
FromPort: 443
ToPort: 443
CidrIp: 0.0.0.0/0
Web Server Launch Template
WebServerLaunchTemplate:
Type: AWS::EC2::LaunchTemplate
AI {•} YAML
Ln 213, Col 26 Spaces: 2 History


main.py
MOSTAFA.yaml
MOSTAFA.yaml
Web Server Launch Template
WebServerLaunchTemplate:
Type: AWS::EC2::LaunchTemplate
Properties:
LaunchTemplateName: WebServerLaunchTemplate
LaunchTemplateData:
KeyName: vockey
ImageId: ami-04d40dba56f6e1303
InstanceType: t2.micro
SecurityGroupIds:
- !Ref WebServerSG
UserData:
Fn::Base64: !Sub |
#!/bin/bash
yum update -y
yum install -y httpd
systemctl start httpd
systemctl enable httpd
echo "<h1>Web Server launched by Auto Scaling Group</h1>" > /var/www/html/index.html
Auto Scaling Group for Web Servers
WebServerAutoScalingGroup:
Type: AWS::AutoScaling::AutoScalingGroup
Properties:
VPCZoneIdentifier:
- !Ref PrivateSubnet1
- !Ref PrivateSubnet2
AI {•} YAML
Ln 213, Col 26 Spaces: 2 History


main.py
MOSTAFA.yaml
MOSTAFA.yaml
- !Ref PrivateSubnet1
- !Ref PrivateSubnet2
LaunchTemplate:
LaunchTemplateId: !Ref WebServerLaunchTemplate
Version: !GetAtt WebServerLaunchTemplate.LatestVersionNumber
MinSize: '2'
MaxSize: '4'
DesiredCapacity: '2'
TargetGroupARNs:
- !Ref ALBTargetGroup
HealthCheckType: ELB
HealthCheckGracePeriod: 300
Tags:
- Key: Name
Value: WebServer
PropagateAtLaunch: true
ALB
ALB:
Type: AWS::ElasticLoadBalancingV2::LoadBalancer
Properties:
Name: MyALB
Subnets:
- !Ref PublicSubnet1
- !Ref PublicSubnet2
Scheme: internet-facing
LoadBalancerAttributes:
- Key: idle_timeout.timeout_seconds
AI {*} YAML
Ln 213, Col 26 Spaces: 2 History

main.py
MOSTAFA.yaml
MOSTAFA.yaml
LoadBalancerAttributes:
- Key: idle_timeout.timeout_seconds
Value: '60'
SecurityGroups:
- !Ref ALBSecurityGroup
Tags:
- Key: Name
Value: MyALB
ALBTargetGroup:
Type: AWS::ElasticLoadBalancingV2::TargetGroup
Properties:
VpcId: !Ref MyVPC
Port: 80
Protocol: HTTP
TargetType: instance
HealthCheckProtocol: HTTP
HealthCheckPort: 80
HealthCheckPath: /
HealthCheckIntervalSeconds: 30
HealthCheckTimeoutSeconds: 5
HealthyThresholdCount: 3
UnhealthyThresholdCount: 2
Tags:
- Key: Name
Value: ALBTargetGroup
ALBListener:

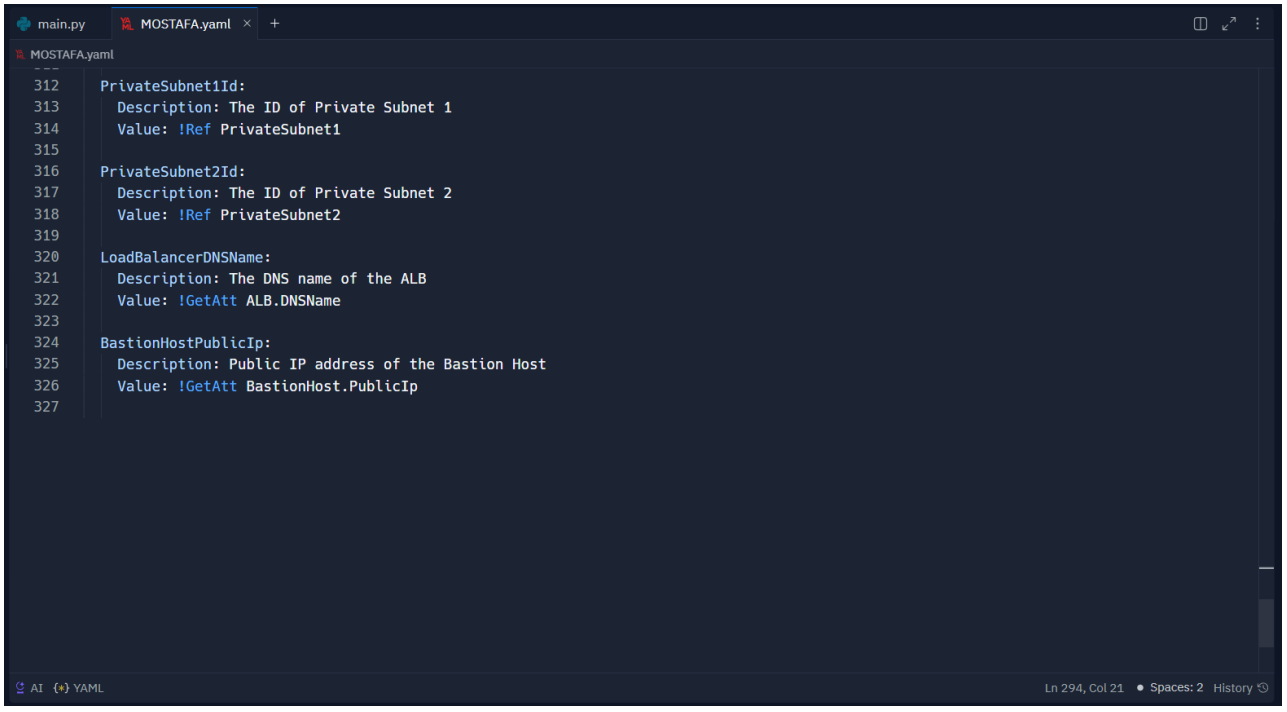
main.py MOSTAFA.yaml

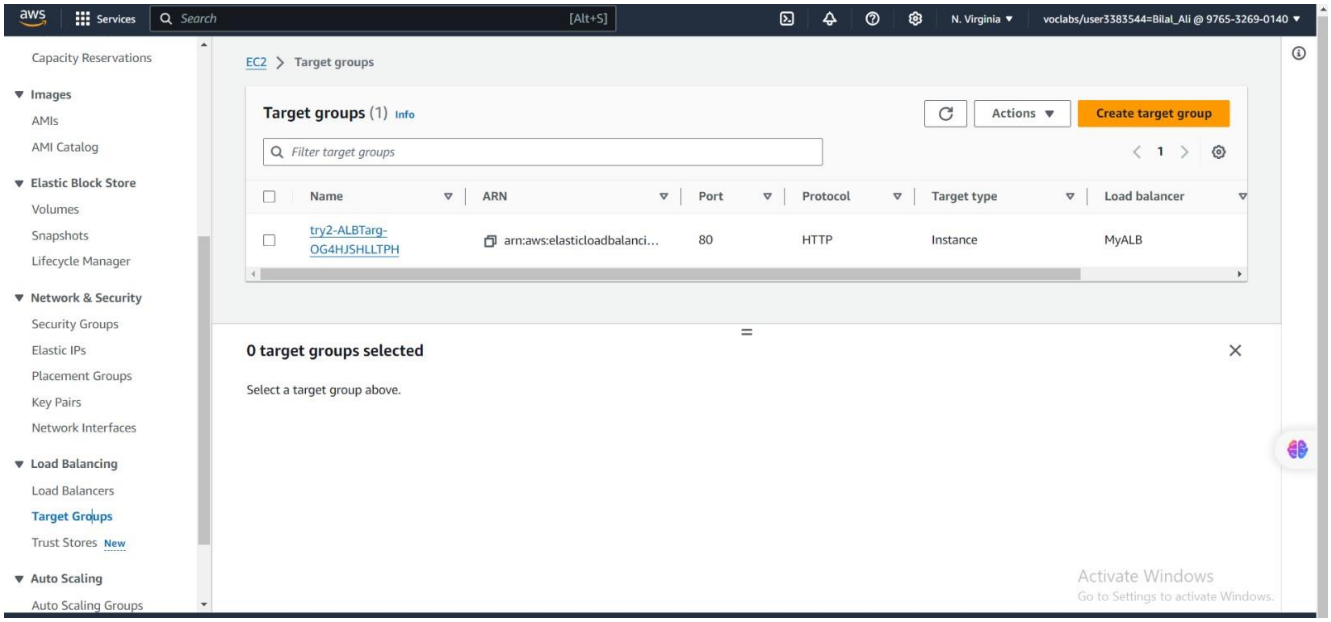
MOSTAFA.yaml

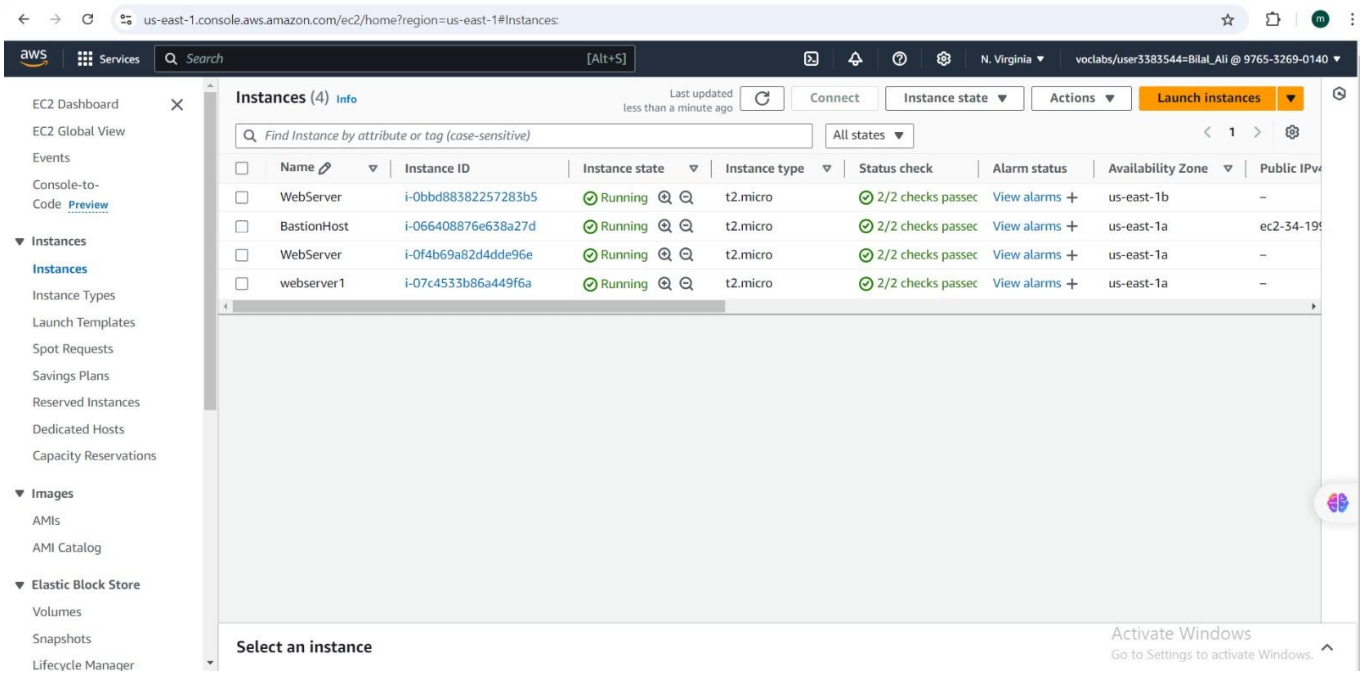
```yaml

  ALBListener:
    Type: AWS::ElasticLoadBalancingV2::Listener
    Properties:
      LoadBalancerArn: !Ref ALB
      Port: 80
      Protocol: HTTP
      DefaultActions:
        - Type: forward
          TargetGroupArn: !Ref ALBTargetGroup

Outputs:
  VPCId:
    Description: The ID of the VPC
    Value: !Ref MyVPC

  PublicSubnet1Id:
    Description: The ID of Public Subnet 1
    Value: !Ref PublicSubnet1

  PublicSubnet2Id:
    Description: The ID of Public Subnet 2
    Value: !Ref PublicSubnet2

  PrivateSubnet1Id:
    Description: The ID of Private Subnet 1
    Value: !Ref PrivateSubnet1

```

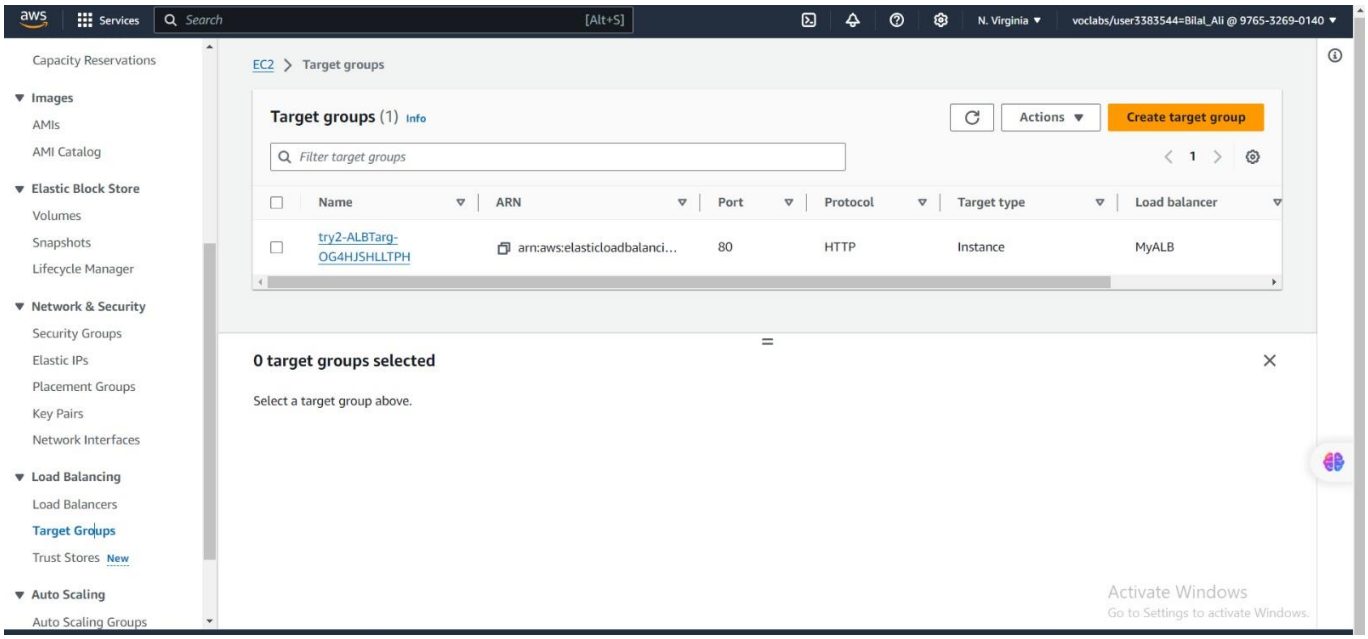
Generate Ctrl I

AI {*} YAML Ln 315, Col 1 Spaces: 2 History




Services
Search
[Alt+S]
N. Virginia
voclabs/user3383544=Bilal_Ali @ 9765-3269-0140
Capacity Reservations
Images
AMIs
AMI Catalog
Elastic Block Store
Volumes
Snapshots
Lifecycle Manager
Network & Security
Security Groups
Elastic IPs
Placement Groups
Key Pairs
Network Interfaces
Load Balancing
Load Balancers
Target Groups
Trust Stores New
Auto Scaling
Auto Scaling Groups
EC2 > Target groups
Target groups (1) Info
Actions
Create target group
Filter target groups
Name
ARN
Port
Protocol
Target type
Load balancer
try2-ALBTarg-OG4HJSHLLTPH
arn:aws:elasticloadbalanci...
80
HTTP
Instance
MyALB
0 target groups selected
Select a target group above.
Activate Windows
Go to Settings to activate Windows.

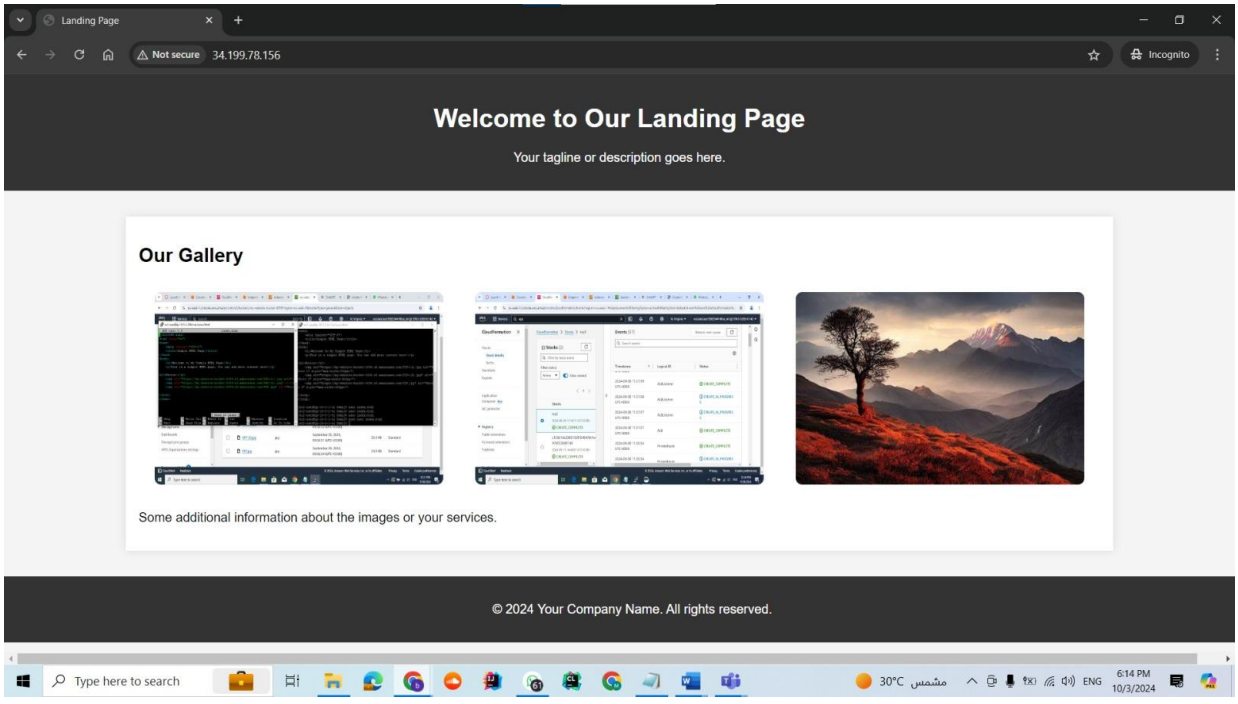

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#Instances:
Services
Search
[Alt+S]
N. Virginia
voclabs/user3383544=Bilal_Ali @ 9765-3269-0140
EC2 Dashboard
EC2 Global View
Events
Console-to-Code Preview
Instances
Instances
Instance Types
Launch Templates
Spot Requests
Savings Plans
Reserved Instances
Dedicated Hosts
Capacity Reservations
Images
AMIs
AMI Catalog
Elastic Block Store
Volumes
Snapshots
Lifecycle Manager
Instances (4) Info
Last updated less than a minute ago
Connect
Instance state
Actions
Launch instances
Find Instance by attribute or tag (case-sensitive)
All states
Name
Instance ID
Instance state
Instance type
Status check
Alarm status
Availability Zone
Public IPv4
WebServer
i-0bbd88382257283b5
Running
t2.micro
2/2 checks passed
View alarms
us-east-1b
BastionHost
i-066408876e638a27d
Running
t2.micro
2/2 checks passed
View alarms
us-east-1a
ec2-34-19
WebServer
i-0f4b69a82d4dde96e
Running
t2.micro
2/2 checks passed
View alarms
us-east-1a
webserver1
i-07c4533b86a449f6a
Running
t2.micro
2/2 checks passed
View alarms
us-east-1a
Select an instance
Activate Windows
Go to Settings to activate Windows.

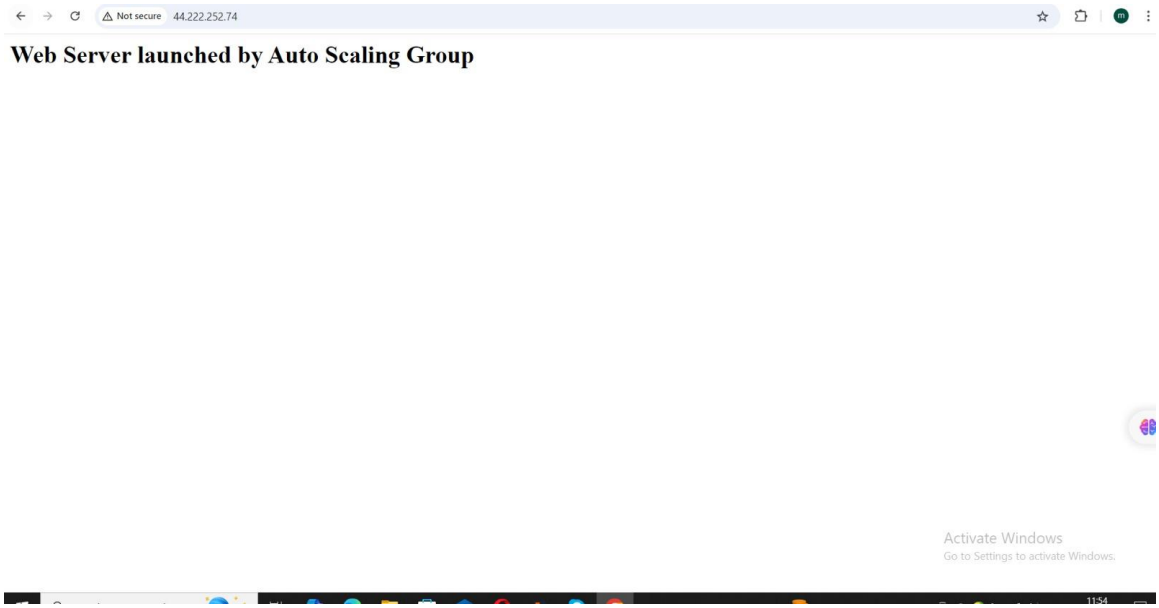


2. Host Web App on EC2 or Using Microservices

Use Amazon EC2 or Amazon ECS/EKS for deploying web apps or containerized microservices.

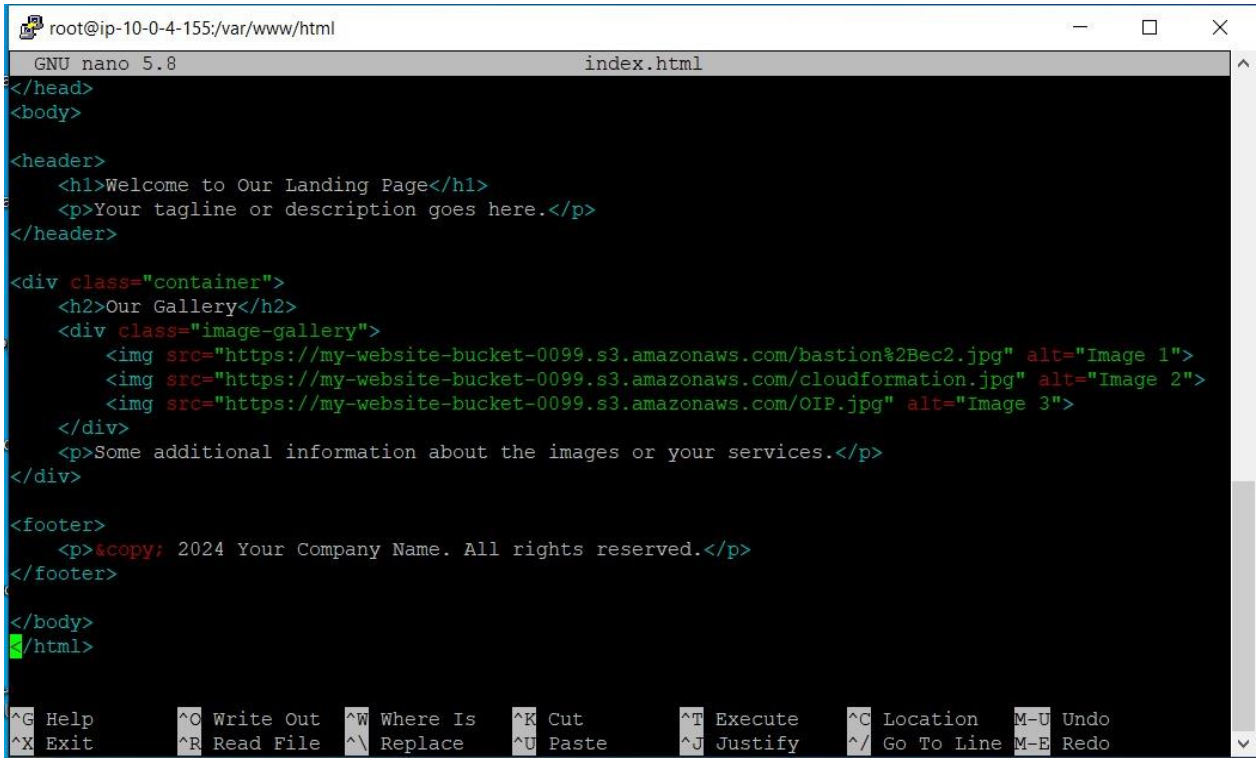
Use Auto Scaling to ensure high availability and scalability. Deploy Elastic Load Balancers across multiple Availability Zones for redundancy and traffic distribution.

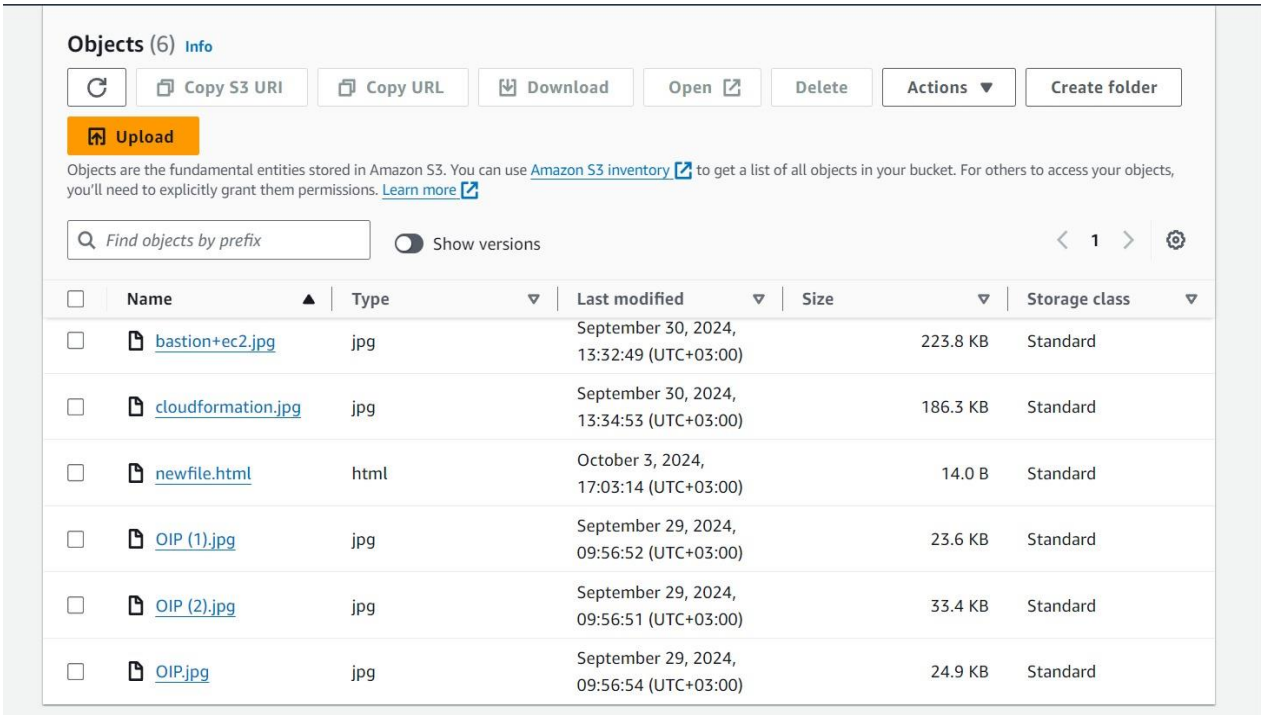




3. Store App Static Content on External Storage (S3)

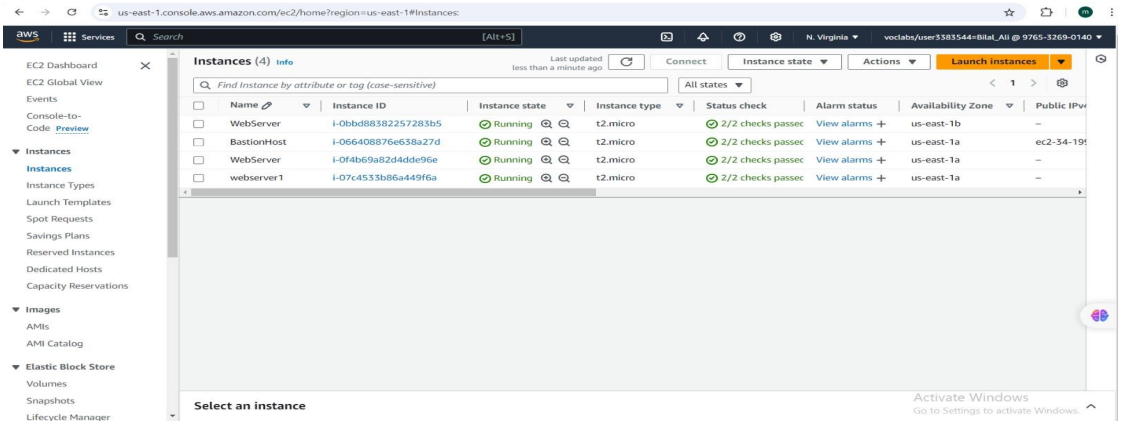
Enable S3 Versioning for backup and recovery and use CloudFront as a CDN to improve latency and user experience globally.



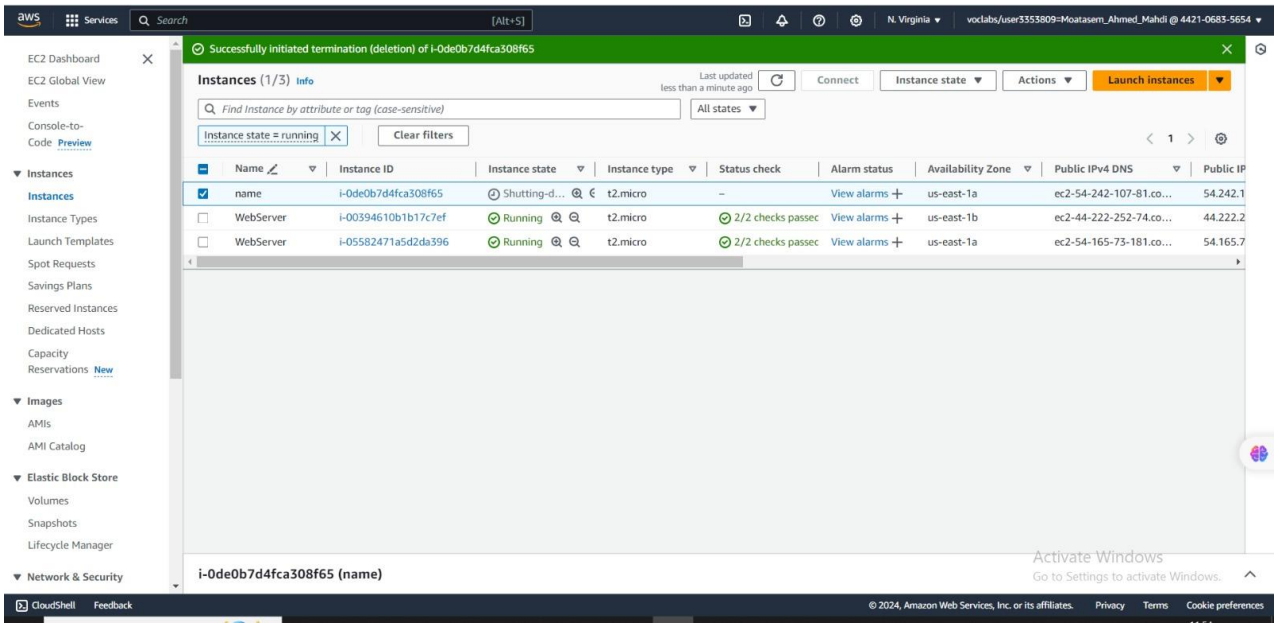


4. Secure, Scalable, High Availability, and Disaster Recovery

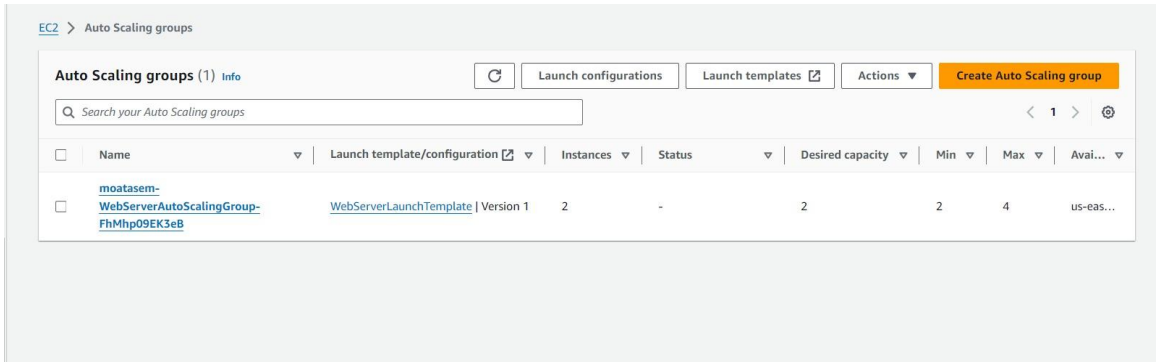
Use IAM for security, Auto Scaling for scalability, and Multi-AZ deployment for high availability.



Highly available with two availability zones



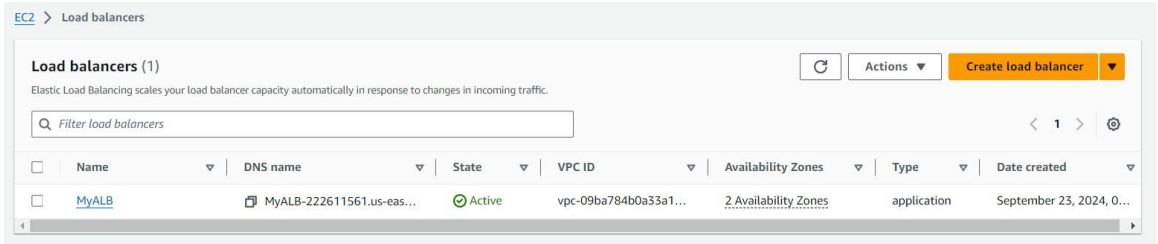
Web server multi-AZ



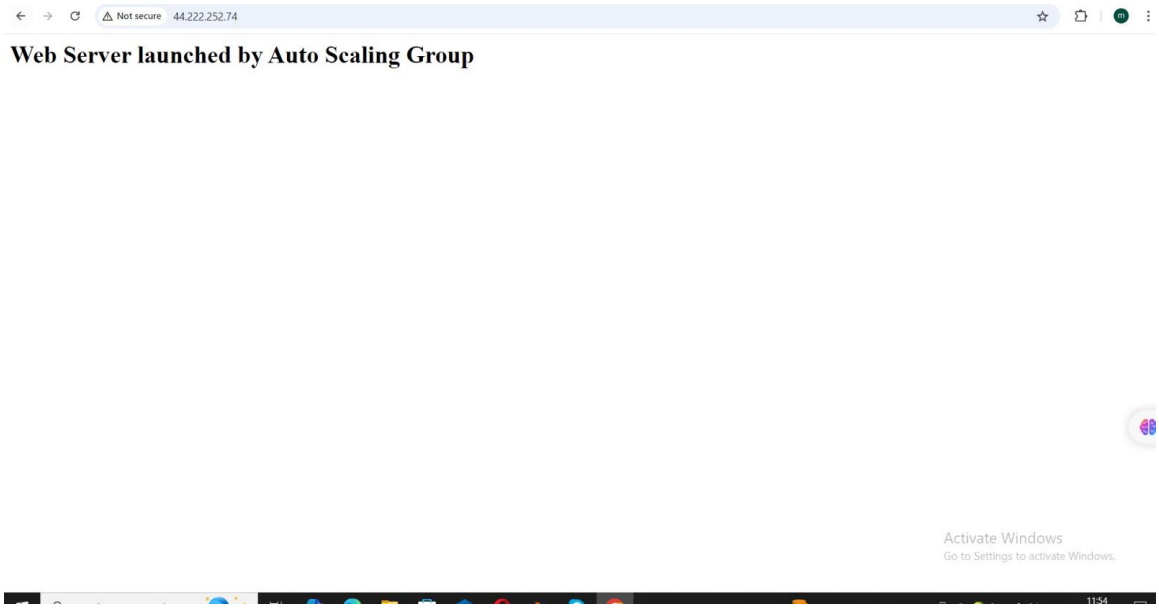
Auto scaling

5. Enable Redirection on Load Balancer (HTTP to HTTPS)

: Use an Application Load Balancer to redirect HTTP requests to HTTPS.

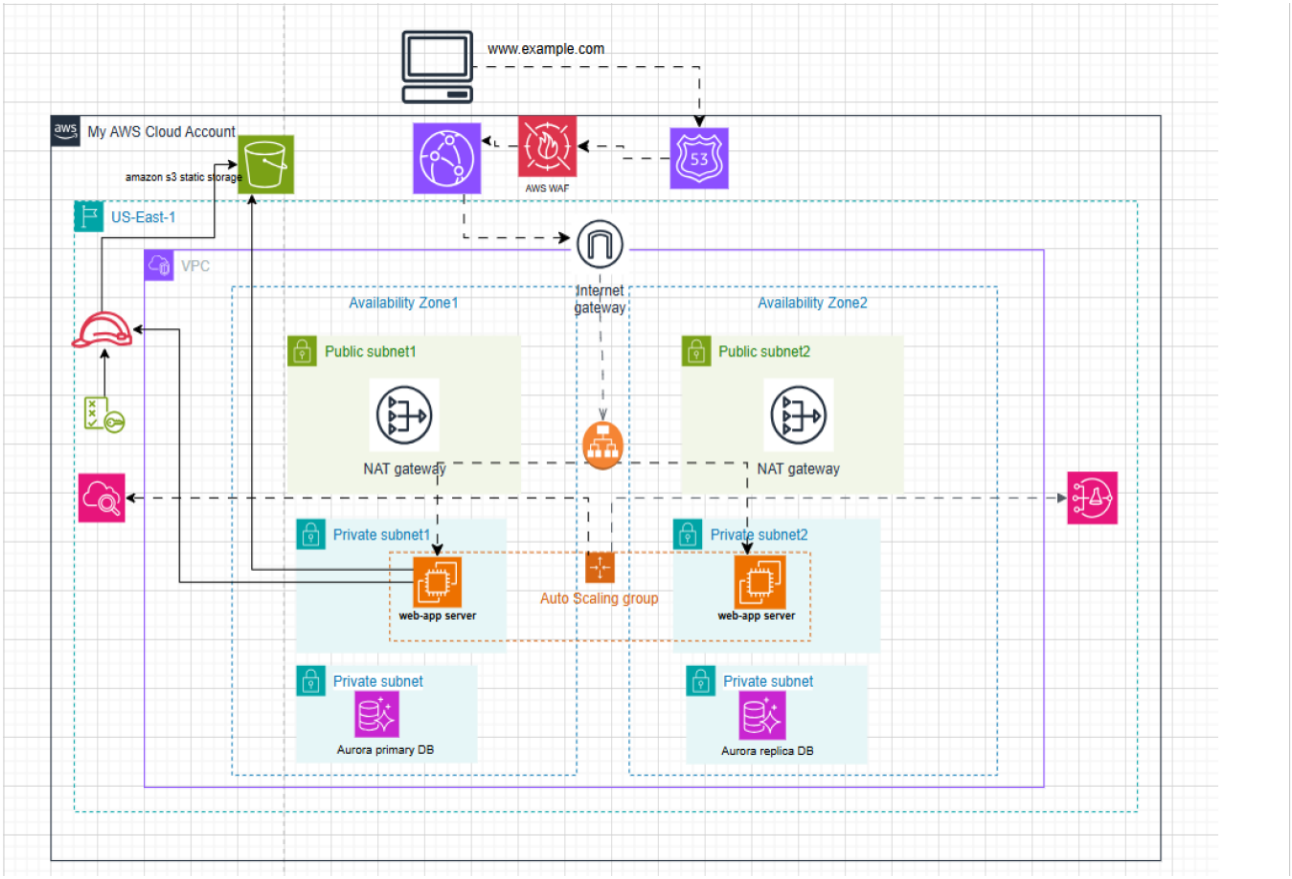


Use SSL/TLS certificates self-signed certificate to ensure encrypted communications.



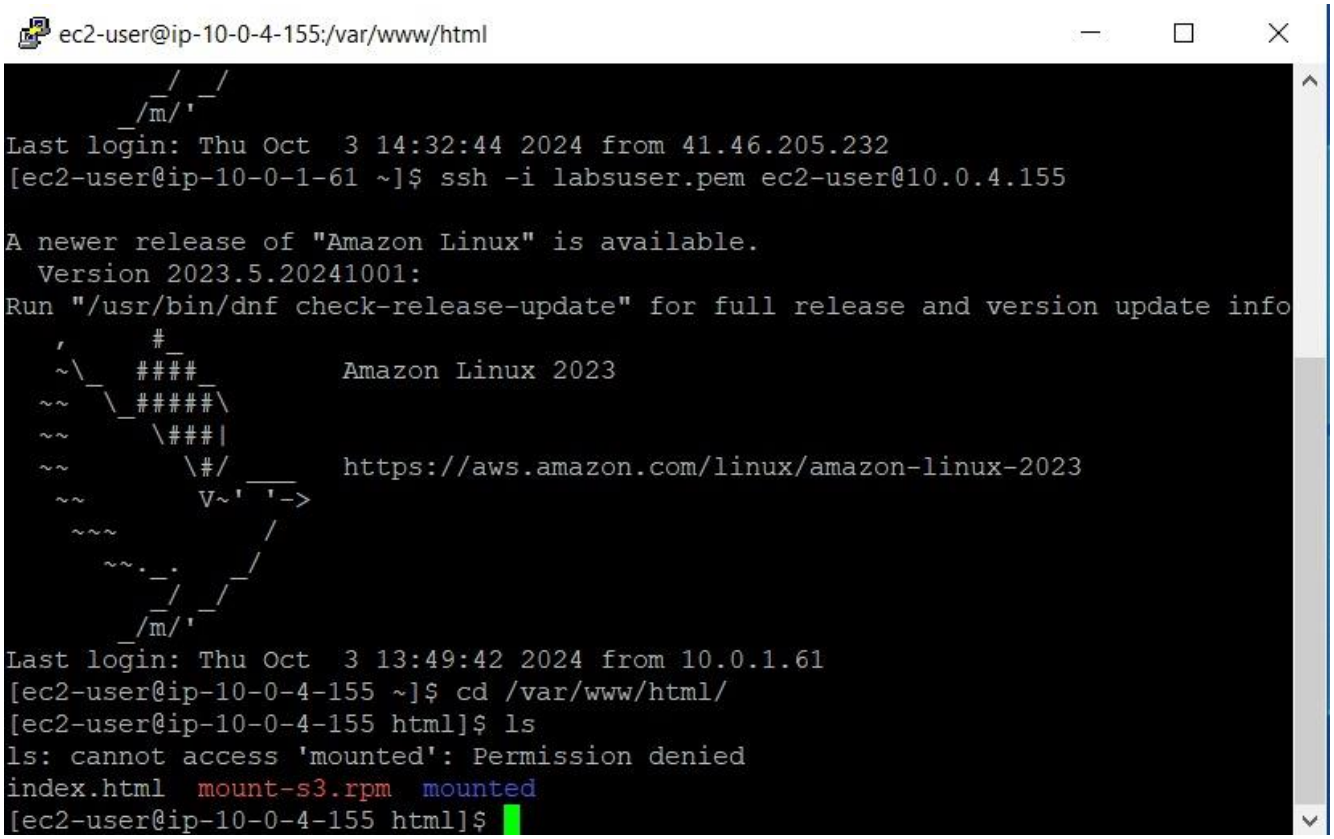
6. DESIGN

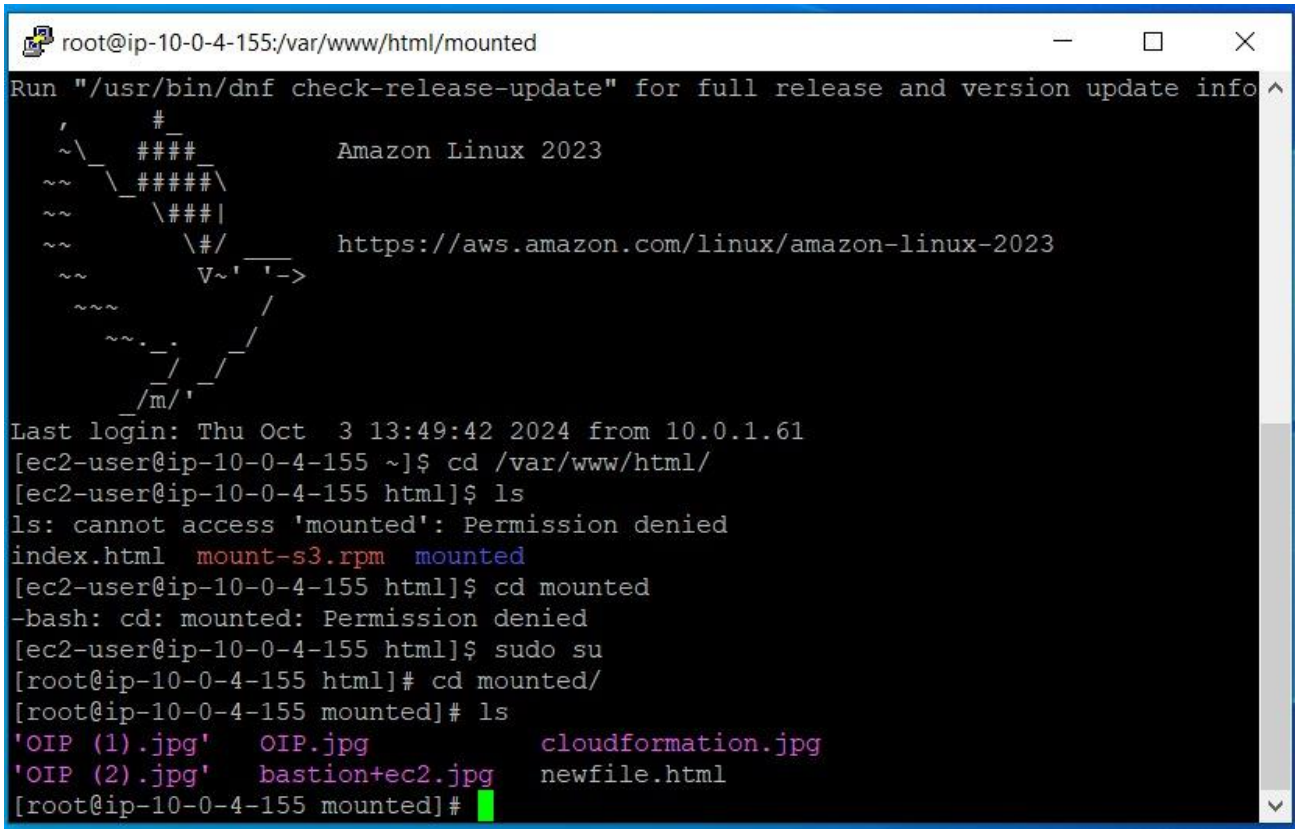
This AWS architecture is designed for scalability, security, and fault tolerance, ensuring a robust cloud-based application deployment. Here is the Architecture Diagram



7. Mount S3 on EC2

: Use s3fs or AWS CLI to mount an S3 bucket on your EC2 instance.





user@34.199.78.156

sudo nano /etc/httpd/conf.d/reverse-proxy.conf

sudo apachectl configtest

<VirtualHost *:80>

ServerName 34.199.78.156 # Replace with your Bastion host's public IP

ProxyPreserveHost On

ProxyPass / http://10.0.3.84:80/ # Replace with your EC2 private IP

ProxyPassReverse / http://10.0.3.84:80/

</VirtualHost>

---

s3fs my-website-bucket-0099 ~/s3-bucket -o passwd_file=~/.passwd-s3fs -o allow_other

sudo s3fs my-website-bucket-0099 /mnt/s3bucket1 -o iam_role=EMR_DefaultRole -o use_cache=/tmp -o allow_other -o uid=1001 -o mp_umask=002 -o multireq_max=5 -o use_path_request_style -o url=https://s3-{{us-east-1}}.amazonaws.com