2025

Implementing a proof-of-concept cloud architecture

CLOUD SERVICES

RAYEN BENTEMESSEK

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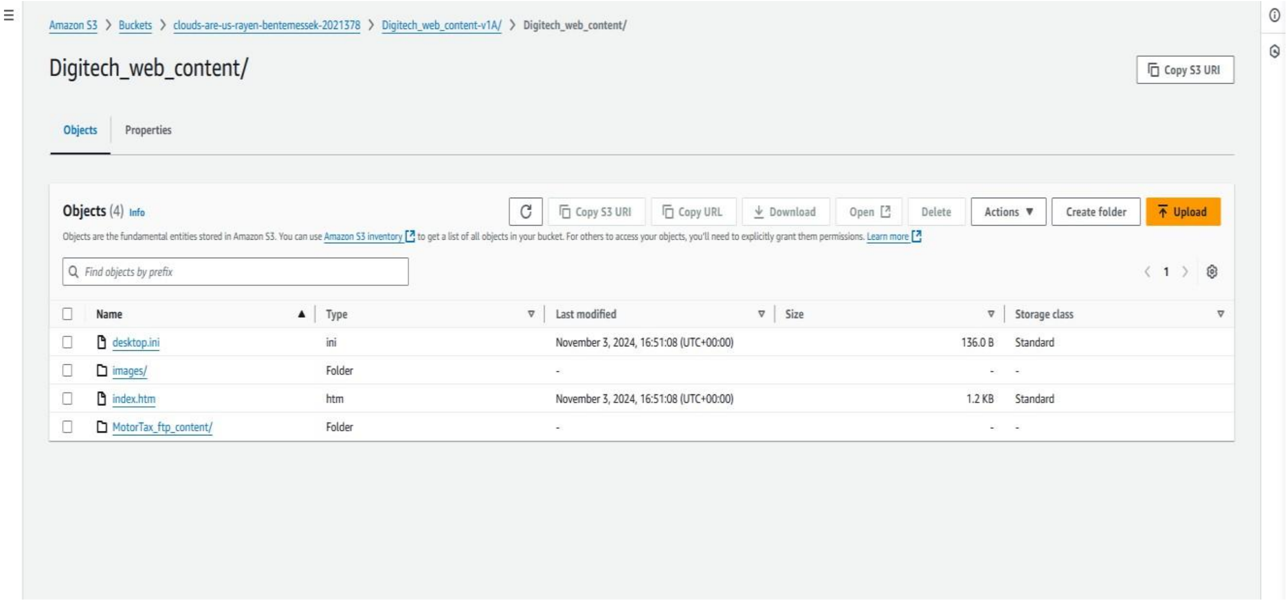
Task 1:

Task 1a:



Amazon S3 > Buckets > clouds-are-us-rayen-bentemessek-2021378 > Digitech_web_content-v1A/ > Digitech_web_content/

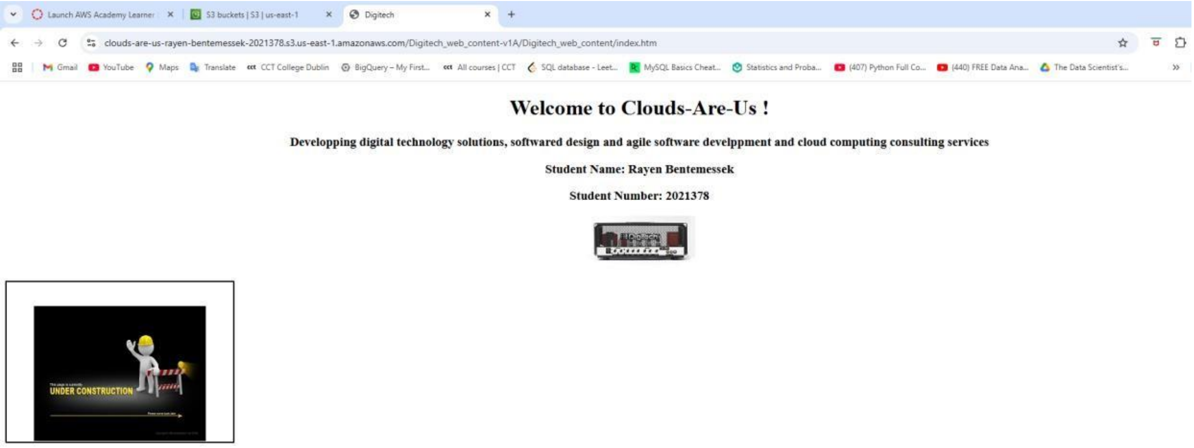
Digitech_web_content/

Objects (4) Info

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

Find objects by prefix

□	Name	Type	Last modified	Size	Storage class
□	desktop.ini	ini	November 3, 2024, 16:51:08 (UTC+00:00)	136.0 B	Standard
□	images/	Folder	-	-	-
□	index.htm	htm	November 3, 2024, 16:51:08 (UTC+00:00)	1.2 KB	Standard
□	MotorTax_ftp_content/	Folder	-	-	-



clouds-are-us-rayen-bentemessek-2021378.s3.us-east-1.amazonaws.com/Digitech_web_content-v1A/Digitech_web_content/index.htm

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Student Name: Rayen Bentemessek

Student Number: 2021378

Task 1b:

AWS S3 is a simple storage service by Amazon useful for hosting website resources such as images and videos and more. S3 is an object-level data storage which means it manages data as objects and stores them in a flat data environment where they are distributed across different machines and allows users to access them using internet from anywhere in the world (GeeksforGeeks, 2021).

AWS EBS, elastic block store, is a block-level storage that stores data files on storage area networks (SAN) in multiple volumes called blocks, these blocks are separate hard drives, and the storage cannot be accessible through the internet unlike the S3 (GeeksforGeeks, 2021).

Key differences:

Characteristic	AWS S3	AWS EBS
Storage type	Object storage	Block storage
Accessibility	Can be retrieved using HTTP or BitTorrent (internet accessible)	Only accessed through the instance connected to
Access control	Access base on IAM, uses bucket policy and can control public access and add restrictions if needed	Security groups and Identity and access management (IAM)
Availability	Accessed through API's	Accessed by a single instance
Durability	Multiple AZ redundancy and highly durable	Single AZ and highly durable
Storage and data size limits	No limits on the number of objects, each object size can be up to 5TB	Maximum storage size of 16 TB, no file size limit on disk
Pricing	Free Tier: 5 GB First 50 TB/month: $0.023/GB 450 TB/month: $0.022/GB Over 500 TB / Month: $0.021 per GB	Free Tier: 30 GB, 1 GB snapshot storage General Purpose: $0.045/GB(1 month) Provisioned SSD: $0.125/GB(1 month)
Scalability	Can be automatically scalable where resources can be provisioned and de-provisioned	Manual scalability to increase or decrease storage resources

Source: (GeeksforGeeks, 2021); (Fayaz, 2023)

Similarities:

- **Security:** Both S3 and EBS support data encryption at rest and in transmission which makes them both highly secure (GeeksforGeeks, 2021).
- **Availability:** Despite having different implementations of availability zones (multi-AZ vs Single AZ) but they both have offer (GeeksforGeeks, 2021).

Use cases:

Amazon S3:

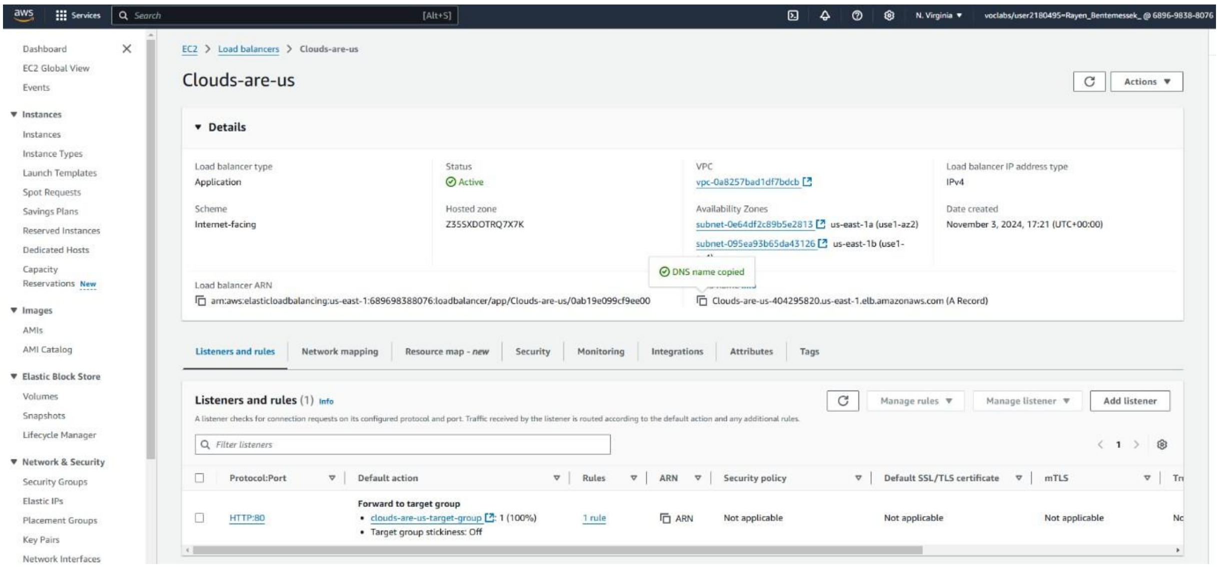
- **Data lake and big data analytics:** Amazon S3 works with AWS Lake formation which will create data lakes that hold raw data in native format and then support big data analytics using machine learning tools, query-in-place and finally draws important insights from the raw data (GeeksforGeeks, 2021).
- **Backup and restoration:** Amazon S3 combined with other services (EBS, EFS, etc) can provide a reliable and robust backup solution (GeeksforGeeks, 2021).
- **Disaster recovery:** S3 provides reliable and powerful data recovery options from different types of disasters such as power outages, systems failures and human errors (GeeksforGeeks, 2021).

Amazon EBS:

- **Software Testing and development:** Amazon EBS is ideal for applications as it connected only to a particular instance which helps in reducing latency and maintains storage in one location (GeeksforGeeks, 2021).
- **Business Continuity:** Amazon EBS provides a high level of consistency throughout different AWS region which can make data persistent making it an ideal solution for businesses to rely on It especially when they are looking for data persistence
(GeeksforGeeks, 2021).
- **Transactional and NoSQL databases:** EBS provides low level of latency which offers a great performance making it a great option for high-performance transactional databases and in database management (GeeksforGeeks, 2021

Task 2:

Task 2a:



Clouds-are-us

Details

Load balancer type
Application

Status
Active

VPC
vpc-0a8257bad1df7bdcb

Load balancer IP address type
IPv4

Scheme
Internet-facing

Hosted zone
Z35SXDOTRQ7X7K

Availability Zones
subnet-0e64df2c89b5e2813 us-east-1a (use1-az2)
subnet-095ea93b65da43126 us-east-1b (use1-

Date created
November 3, 2024, 17:21 (UTC+00:00)

DNS name copied

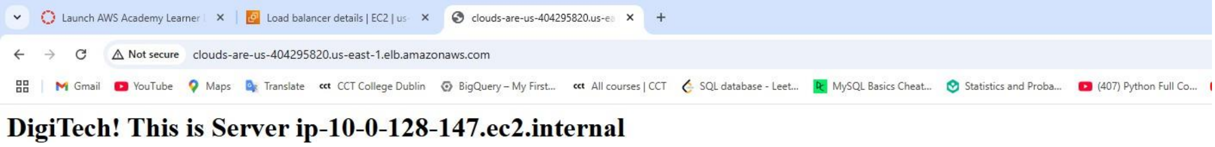
Load balancer ARN
arn:aws:elasticloadbalancing:us-east-1:689698388076:loadbalancer/app/Clouds-are-us/0ab19e099cf9ee00

Clouds-are-us-404295820.us-east-1.elb.amazonaws.com (A Record)

Listeners and rules (1) Info

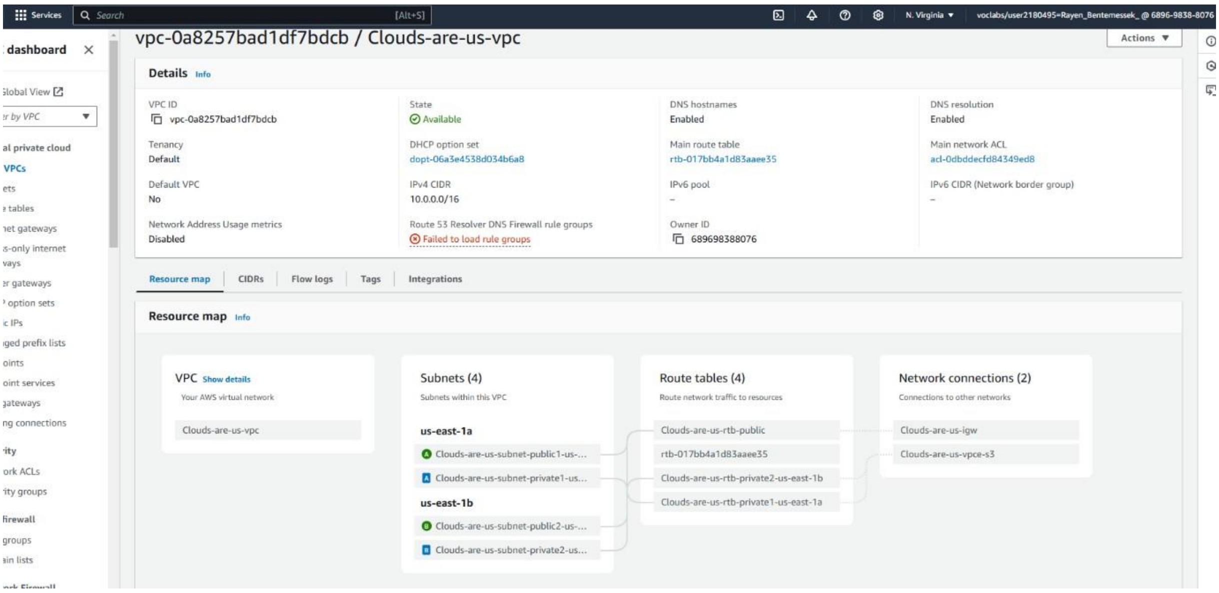
A listener checks for connection requests on its configured protocol and port. Traffic received by the listener is routed according to the default action and any additional rules.

□	Protocol:Port	Default action	Rules	ARN	Security policy	Default SSL/TLS certificate	mTLS	Tr
□	HTTP:80	Forward to target group • clouds-are-us-target-group: 1 (100%) • Target group stickiness: Off	1 rule	ARN	Not applicable	Not applicable	Not applicable	Nc



clouds-are-us-404295820.us-east-1.elb.amazonaws.com

DigiTech! This is Server ip-10-0-128-147.ec2.internal



vpc-0a8257bad1df7bdcb / Clouds-are-us-vpc

Details Info

VPC ID
vpc-0a8257bad1df7bdcb

State
Available

DNS hostnames
Enabled

DNS resolution
Enabled

Tenancy
Default

DHCP option set
dopt-06a3e4538d034b6a8

Main route table
rtb-017bb4a1d83aaee35

Main network ACL
acl-0dbddecfd84349ed8

Default VPC
No

IPv4 CIDR
10.0.0.0/16

IPv6 pool
–

IPv6 CIDR (Network border group)
–

Network Address Usage metrics
Disabled

Route 53 Resolver DNS Firewall rule groups
Failed to load rule groups

Owner ID
689698388076

Resource map Info

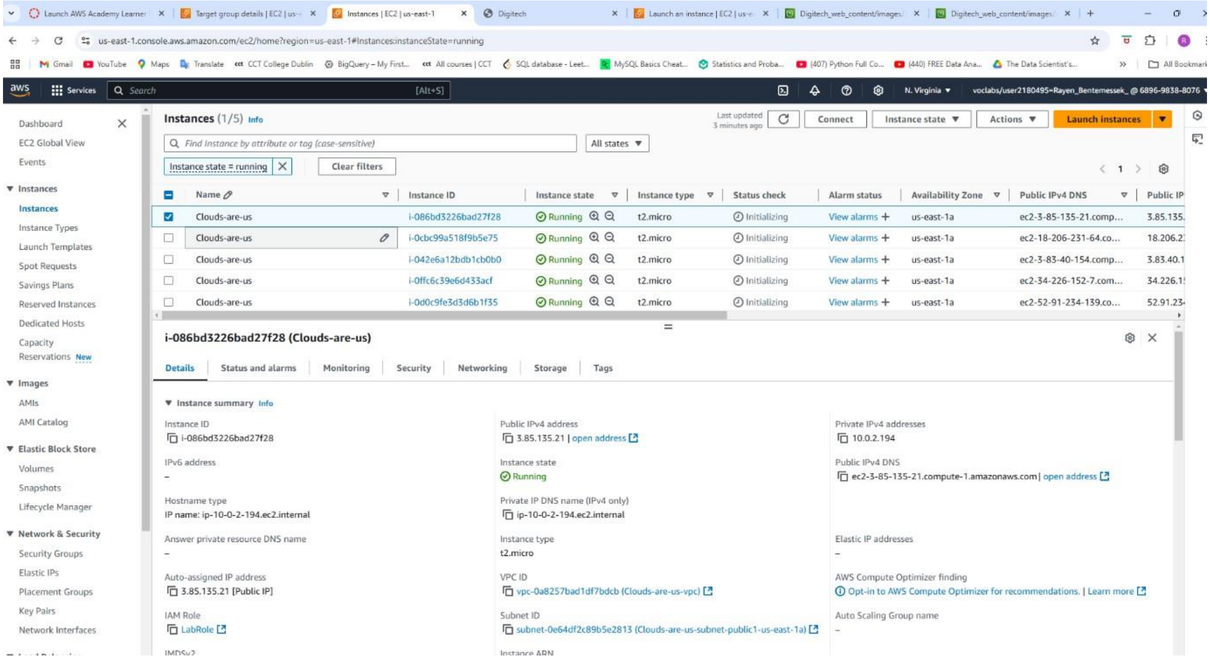
VPC Show details
Your AWS virtual network
Clouds-are-us-vpc

Subnets (4)
Subnets within this VPC
us-east-1a
Clouds-are-us-subnet-public1-us-...
Clouds-are-us-subnet-private1-us...
us-east-1b
Clouds-are-us-subnet-public2-us-...
Clouds-are-us-subnet-private2-us...

Route tables (4)
Route network traffic to resources
Clouds-are-us-rtb-public
rtb-017bb4a1d83aaee35
Clouds-are-us-rtb-private2-us-east-1b
Clouds-are-us-rtb-private1-us-east-1a

Network connections (2)
Connections to other networks
Clouds-are-us-igw
Clouds-are-us-vpce-s3

This picture shows the implementation of a custom VP



Instances (1/5) Info

Instance state = running

	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IP
☑	Clouds-are-us	i-086bd3226bad27f28	Running	t2.micro	Initializing	View alarms +	us-east-1a	ec2-3-85-135-21.comp...	3.85.135.
□	Clouds-are-us	i-0cbc99a518f9b5e75	Running	t2.micro	Initializing	View alarms +	us-east-1a	ec2-18-206-231-64.co...	18.206.2
□	Clouds-are-us	i-042e6a12bdb1cb0b0	Running	t2.micro	Initializing	View alarms +	us-east-1a	ec2-3-83-40-154.comp...	3.83.40.1
□	Clouds-are-us	i-0ffc6c39e6d433acf	Running	t2.micro	Initializing	View alarms +	us-east-1a	ec2-34-226-152-7.com...	34.226.1
□	Clouds-are-us	i-0d0c9fe3d3d6b1f35	Running	t2.micro	Initializing	View alarms +	us-east-1a	ec2-52-91-234-139.co...	52.91.23

i-086bd3226bad27f28 (Clouds-are-us)

Instance summary Info

Instance ID
i-086bd3226bad27f28

IPv6 address
–

Hostname type
IP name: ip-10-0-2-194.ec2.internal

Answer private resource DNS name
–

Auto-assigned IP address
3.85.135.21 [Public IP]

IAM Role
LabRole

IMDSv2

Public IPv4 address
3.85.135.21 | open address

Instance state
Running

Private IP DNS name (IPv4 only)
ip-10-0-2-194.ec2.internal

Instance type
t2.micro

VPC ID
vpc-0a8257bad1df7bdcb (Clouds-are-us-vpc)

Subnet ID
subnet-0e64df2c89b5e2813 (Clouds-are-us-subnet-public1-us-east-1a)

Instance ARN

Private IPv4 addresses
10.0.2.194

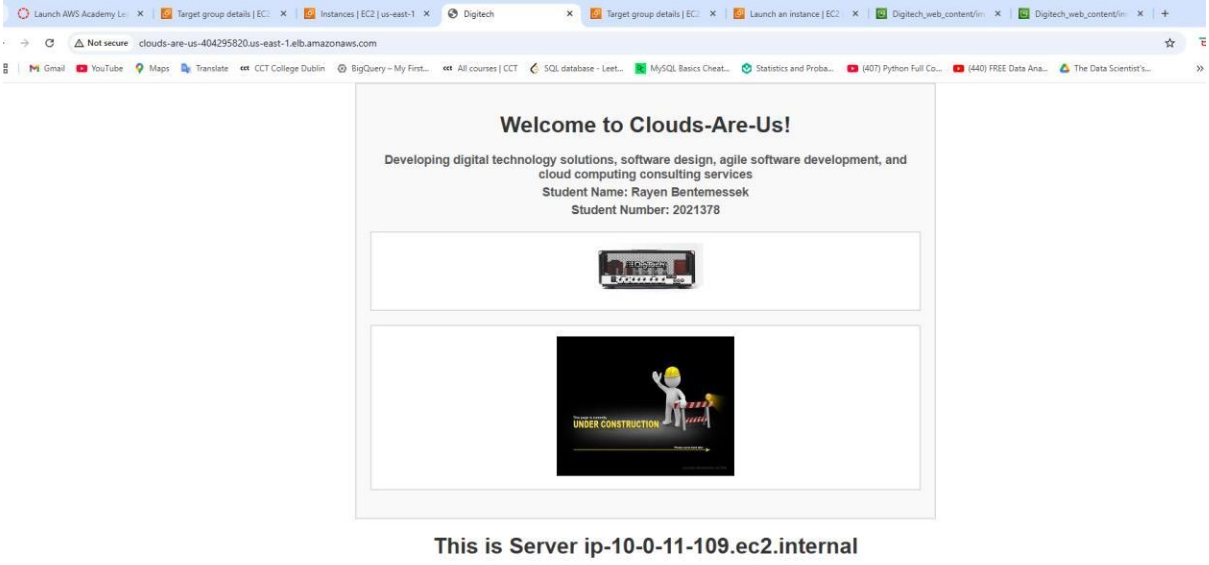
Public IPv4 DNS
ec2-3-85-135-21.compute-1.amazonaws.com | open address

Elastic IP addresses
–

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

Auto Scaling Group name
–

Task 2b:



clouds-are-us-404295820.us-east-1.elb.amazonaws.com

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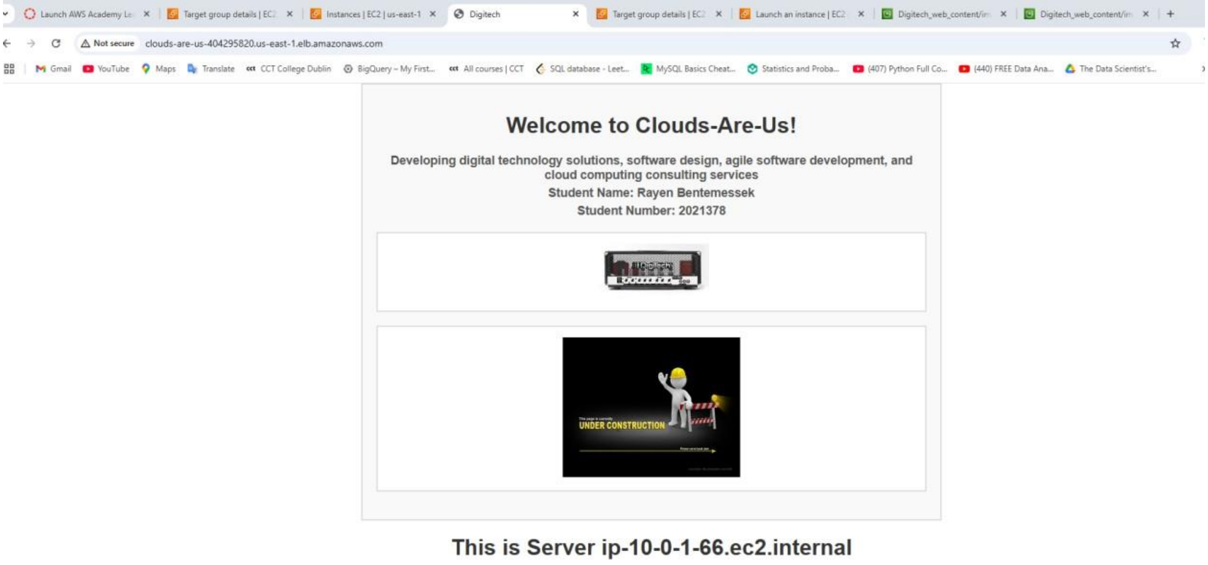
Student Name: Rayen Bentemessek

Student Number: 2021378

This is Server ip-10-0-11-109.ec2.internal



clouds-are-us-404295820.us-east-1.elb.amazonaws.com

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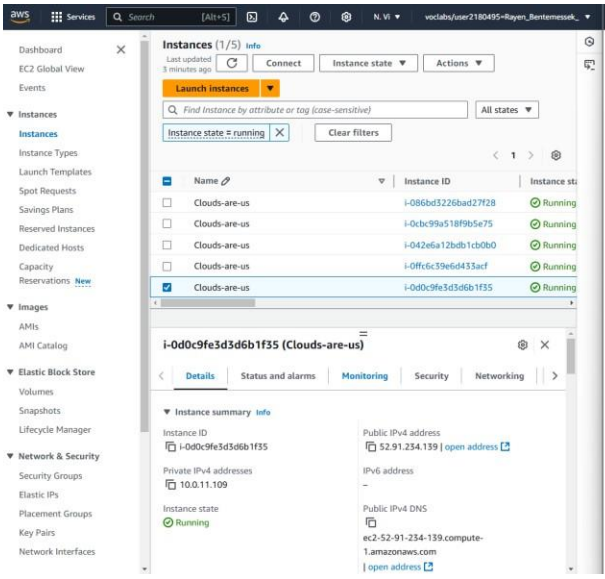
Student Name: Rayen Bentemessek

Student Number: 2021378

This is Server ip-10-0-1-66.ec2.internal



Instances (1/5) Info

Last updated 3 minutes ago

Instance state = running

	Name	Instance ID	Instance st
□	Clouds-are-us	i-086bd3226bad27f28	Running
□	Clouds-are-us	i-0cbc99a518f9b5e75	Running
□	Clouds-are-us	i-042e6a12bdb1cb0b0	Running
□	Clouds-are-us	i-0ffc6c39e6d433acf	Running
☑	Clouds-are-us	i-0d0c9fe3d3d6b1f35	Running

i-0d0c9fe3d3d6b1f35 (Clouds-are-us)

Instance summary Info

Instance ID: i-0d0c9fe3d3d6b1f35

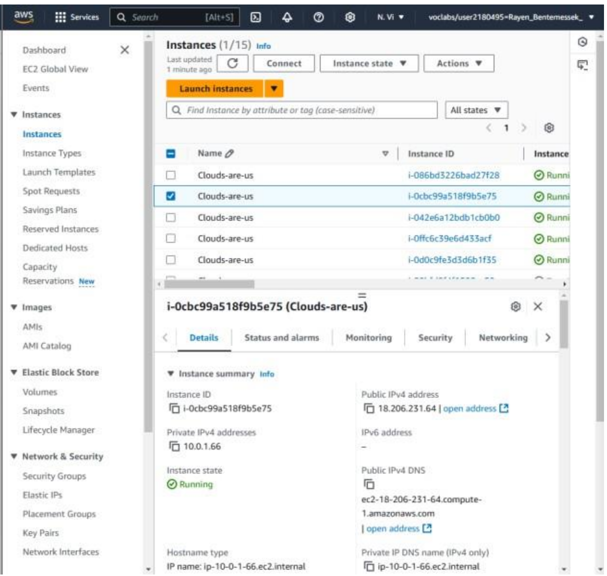
Public IPv4 address: 52.91.234.139 | open address

Private IPv4 addresses: 10.0.11.109

IPv6 address: –

Instance state: Running

Public IPv4 DNS: ec2-52-91-234-139.compute-1.amazonaws.com | open address



Instances (1/15) Info

Last updated 1 minute ago

	Name	Instance ID	Instance
□	Clouds-are-us	i-086bd3226bad27f28	Runni
☑	Clouds-are-us	i-0cbc99a518f9b5e75	Runni
□	Clouds-are-us	i-042e6a12bdb1cb0b0	Runni
□	Clouds-are-us	i-0ffc6c39e6d433acf	Runni
□	Clouds-are-us	i-0d0c9fe3d3d6b1f35	Runni

i-0cbc99a518f9b5e75 (Clouds-are-us)

Instance summary Info

Instance ID: i-0cbc99a518f9b5e75

Public IPv4 address: 18.206.231.64 | open address

Private IPv4 addresses: 10.0.1.66

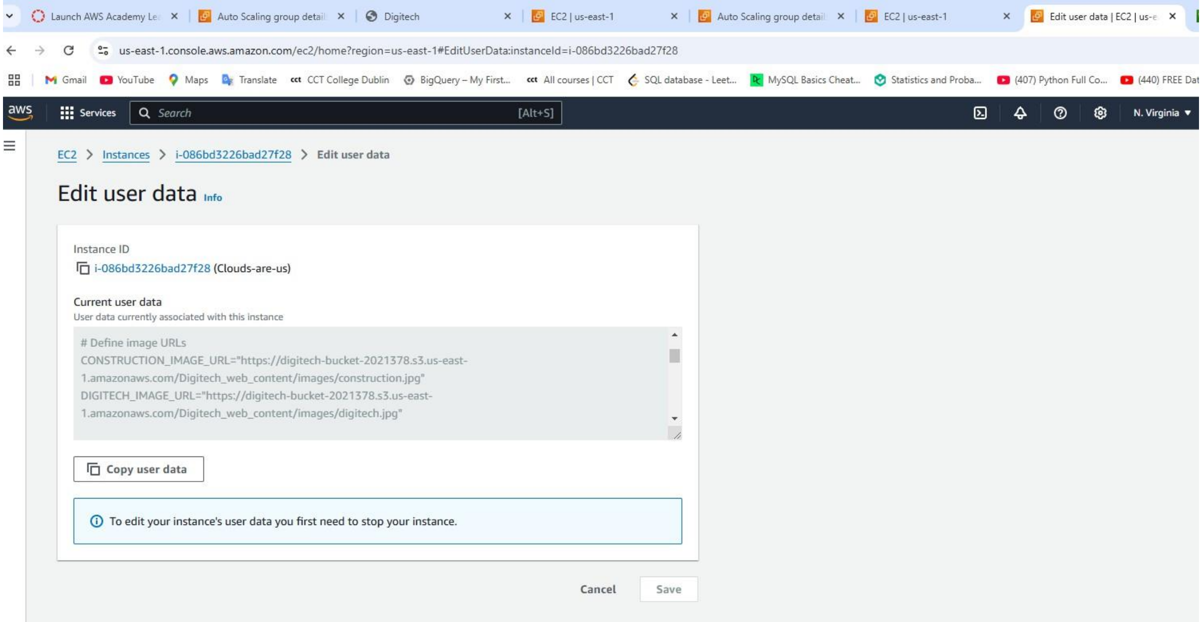
IPv6 address: –

Instance state: Running

Public IPv4 DNS: ec2-18-206-231-64.compute-1.amazonaws.com | open address

Hostname type: IP name: ip-10-0-1-66.ec2.internal

Private IP DNS name (IPv4 only): ip-10-0-1-66.ec2.internal



Edit user data Info

Instance ID
i-086bd3226bad27f28 (Clouds-are-us)

Current user data
User data currently associated with this instance

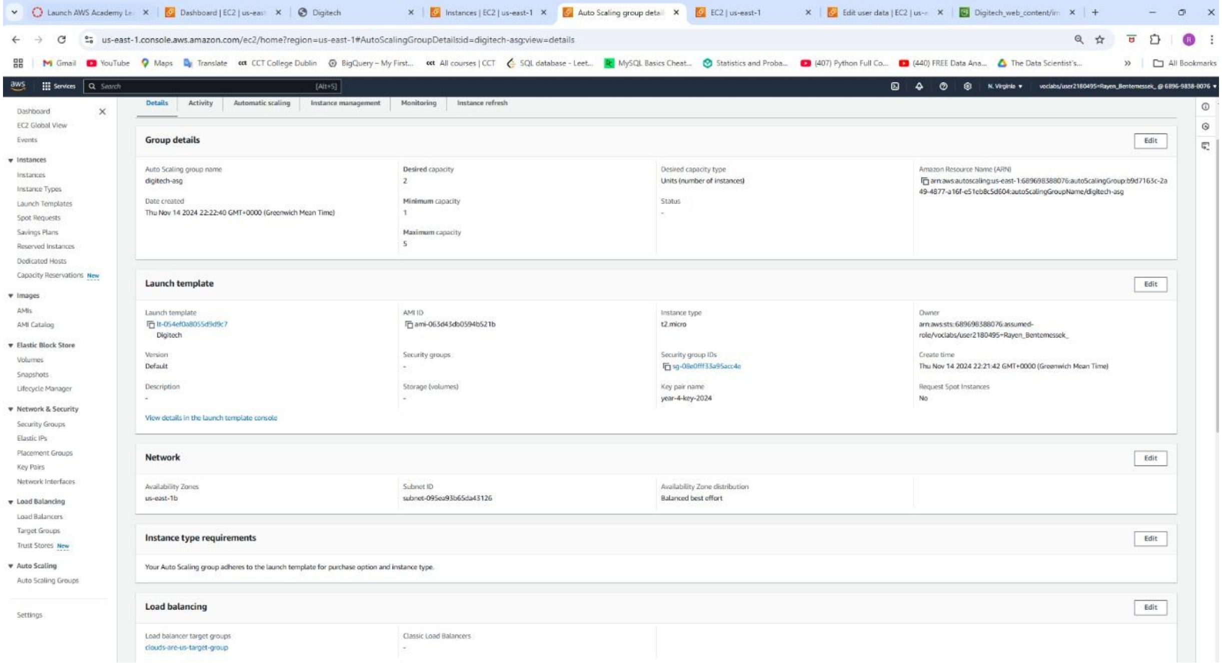
```
# Define image URLs
CONSTRUCTION_IMAGE_URL="https://digitech-bucket-2021378.s3.us-east-1.amazonaws.com/Digitech_web_content/images/construction.jpg"
DIGITECH_IMAGE_URL="https://digitech-bucket-2021378.s3.us-east-1.amazonaws.com/Digitech_web_content/images/digitech.jpg"
```

To edit your instance's user data you first need to stop your instance.

This task was a little bit tricky because I had too many issues in the beginning as I was trying to access the whole website from the S3 bucket using a script but that didn’t work because of IAM roles permissions, so what I did is create the HTML page in the script and only access the images through their S3 URLS as shown in the screenshot above. This worked eventually and I managed to display the desired websites across the five instances showing each unique IP address using a custom VPC called clouds-are-us as shown in the task 2a.

Task 3:

Task 3a:



us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#AutoScalingGroupDetails:id=digitech-asg;view=details

Group details

Auto Scaling group name: digitech-asg
Date created: Thu Nov 14 2024 22:22:40 GMT+0000 (Greenwich Mean Time)
Desired capacity: 2
Minimum capacity: 1
Maximum capacity: 5
Desired capacity type: Units (number of instances)
Status: -
Amazon Resource Name (ARN): arn:aws:autoscaling:us-east-1:689698388076:autoScalingGroup:b9d7163c-2a49-4877-a16f-e51eb8c5d604:autoScalingGroupName/digitech-asg

Launch template

Launch template: lt-054ef0a8055d9d9c7 Digitech
Version: Default
Description: -
AMI ID: ami-063d43db0594b521b
Security groups: -
Storage (volumes): -
Instance type: t2.micro
Security group IDs: sg-08e0fff33a95acc4e
Key pair name: year-4-key-2024
Owner: arn:aws:sts::689698388076:assumed-role/voclabs/user2180495=Rayen_Bentemessek_
Create time: Thu Nov 14 2024 22:21:42 GMT+0000 (Greenwich Mean Time)
Request Spot Instances: No

View details in the launch template console

Network

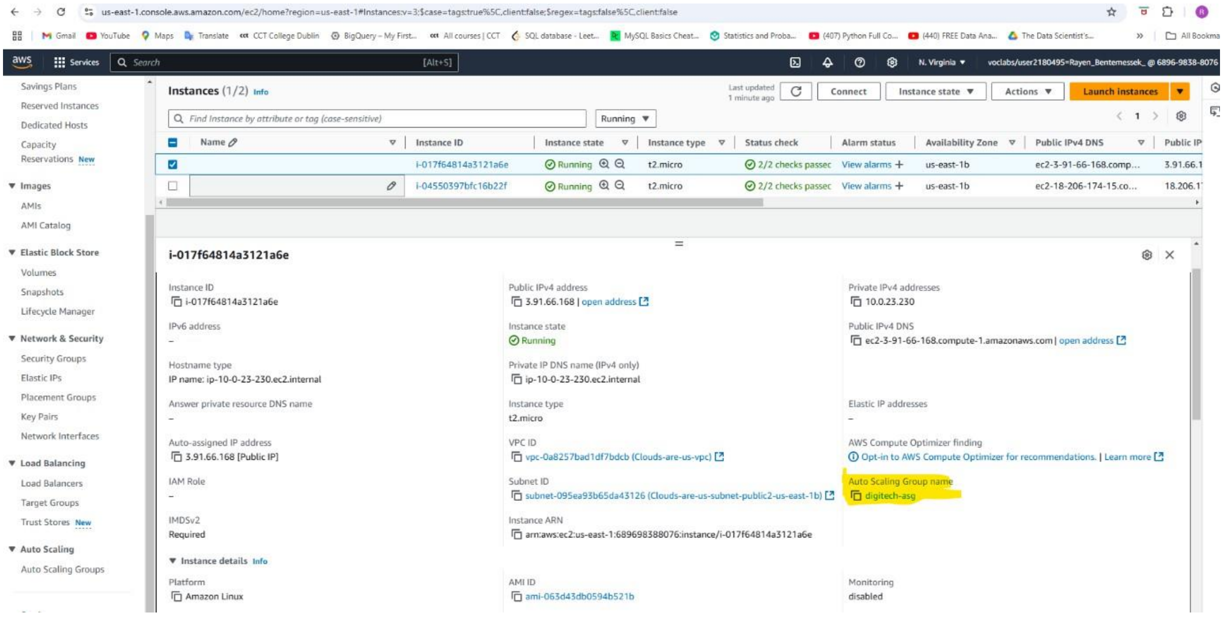
Availability Zones: us-east-1b
Subnet ID: subnet-095ea93b65da43126
Availability Zone distribution: Balanced best effort

Instance type requirements

Your Auto Scaling group adheres to the launch template for purchase option and instance type.

Load balancing

Load balancer target groups: clouds-are-us-target-group
Classic Load Balancers: -



us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#Instances:v=3;$case=tags:true%5C,client:false;$regex=tags:false%5C,client:false

Instances (1/2) Info

Last updated 1 minute ago

	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IP
☑		i-017f64814a3121a6e	Running	t2.micro	2/2 checks passec	View alarms +	us-east-1b	ec2-3-91-66-168.comp...	3.91.66.1
□		i-04550397bfc16b22f	Running	t2.micro	2/2 checks passec	View alarms +	us-east-1b	ec2-18-206-174-15.co...	18.206.1

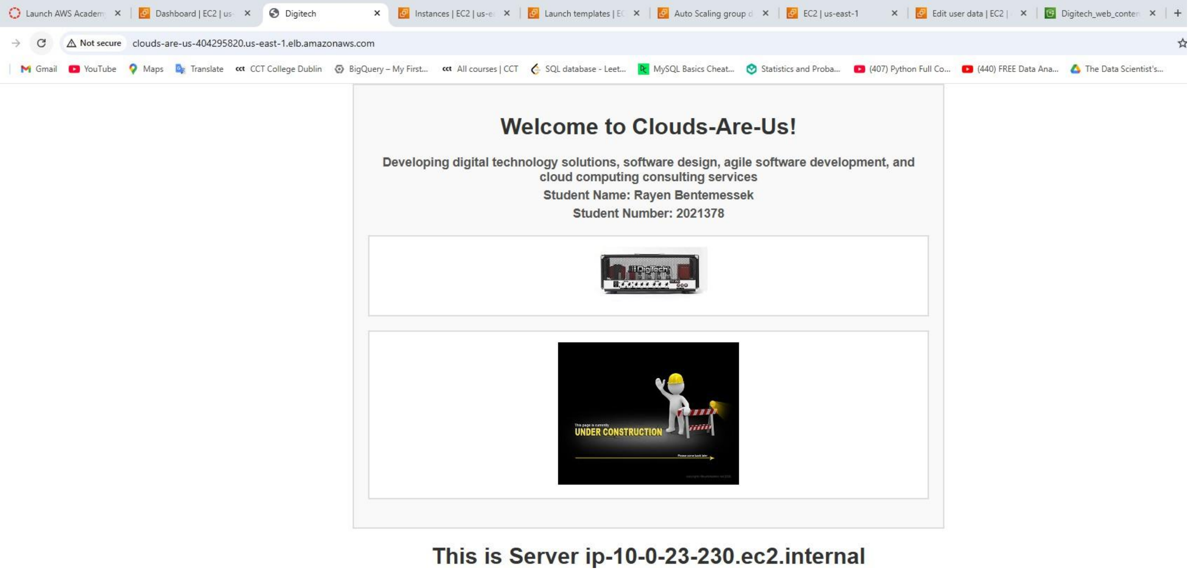
i-017f64814a3121a6e

Instance ID: i-017f64814a3121a6e
IPv6 address: –
Hostname type: IP name: ip-10-0-23-230.ec2.internal
Answer private resource DNS name: –
Auto-assigned IP address: 3.91.66.168 [Public IP]
IAM Role: –
IMDSv2: Required
Public IPv4 address: 3.91.66.168 | open address
Instance state: Running
Private IP DNS name (IPv4 only): ip-10-0-23-230.ec2.internal
Instance type: t2.micro
VPC ID: vpc-0a8257bad1df7bdcb (Clouds-are-us-vpc)
Subnet ID: subnet-095ea93b65da43126 (Clouds-are-us-subnet-public2-us-east-1b)
Instance ARN: arn:aws:ec2:us-east-1:689698388076:instance/i-017f64814a3121a6e
Private IPv4 addresses: 10.0.23.230
Public IPv4 DNS: ec2-3-91-66-168.compute-1.amazonaws.com | open address
Elastic IP addresses: –
AWS Compute Optimizer finding: Opt-in to AWS Compute Optimizer for recommendations. | Learn more
Auto Scaling Group name: digitech-asg

▼ Instance details Info

Platform: Amazon Linux
AMI ID: ami-063d43db0594b521b
Monitoring: disabled

I created the ASG, used the same script in task 2b in the launch template, I created it with a desired capacity of 2 instances at first and later I have manually scaled up and changed desired capacity to 4 instances to show that the ASG is working perfectly for what we need it for.



Not secure clouds-are-us-404295820.us-east-1.elb.amazonaws.com

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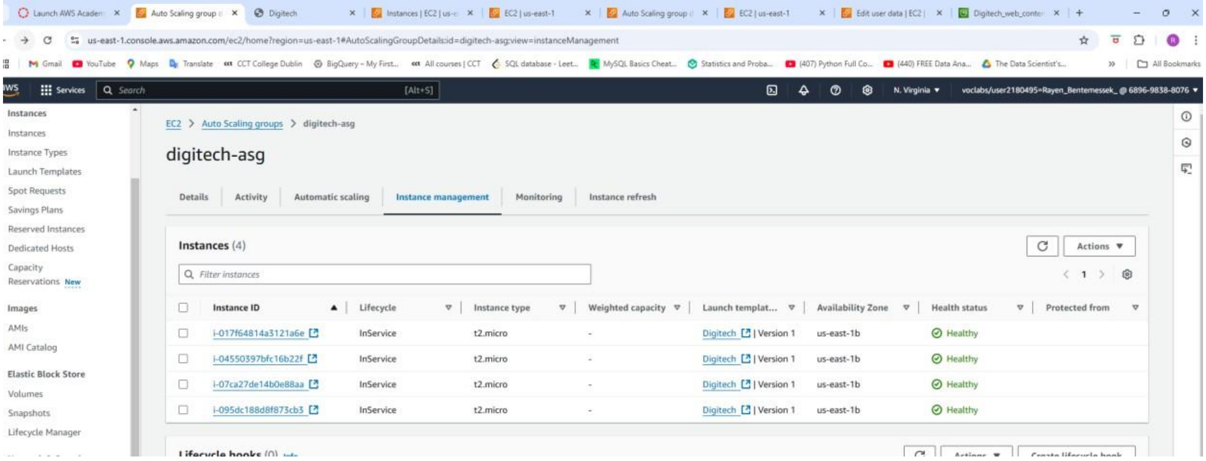
Student Name: Rayen Bentemessek

Student Number: 2021378

This is Server ip-10-0-23-230.ec2.internal



us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#AutoScalingGroupDetails:id=digitech-asg;view=instanceManagement

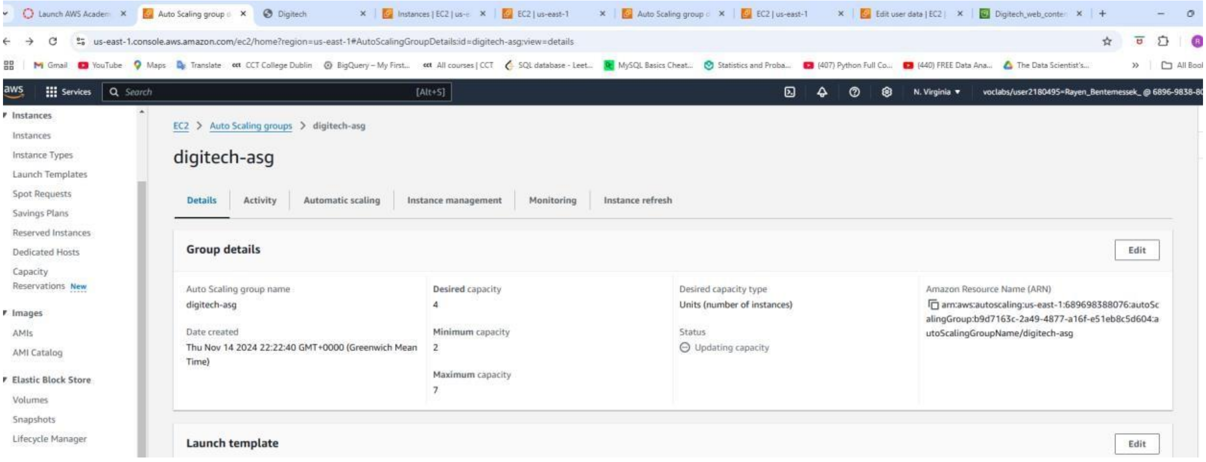
EC2 > Auto Scaling groups > digitech-asg

digitech-asg

Instances (4)

Instance ID	Lifecycle	Instance type	Weighted capacity	Launch templat...	Availability Zone	Health status	Protected from
i-017f64814a3121a6e	InService	t2.micro	-	Digitech | Version 1	us-east-1b	Healthy	
i-04550397bfc16b22f	InService	t2.micro	-	Digitech | Version 1	us-east-1b	Healthy	
i-07ca27de14b0e88aa	InService	t2.micro	-	Digitech | Version 1	us-east-1b	Healthy	
i-095dc188d8f873cb3	InService	t2.micro	-	Digitech | Version 1	us-east-1b	Healthy	

Lifecycle hooks (0)



us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#AutoScalingGroupDetails:id=digitech-asg;view=details

EC2 > Auto Scaling groups > digitech-asg

digitech-asg

Group details

Auto Scaling group name
digitech-asg

Date created
Thu Nov 14 2024 22:22:40 GMT+0000 (Greenwich Mean Time)

Desired capacity
4

Minimum capacity
2

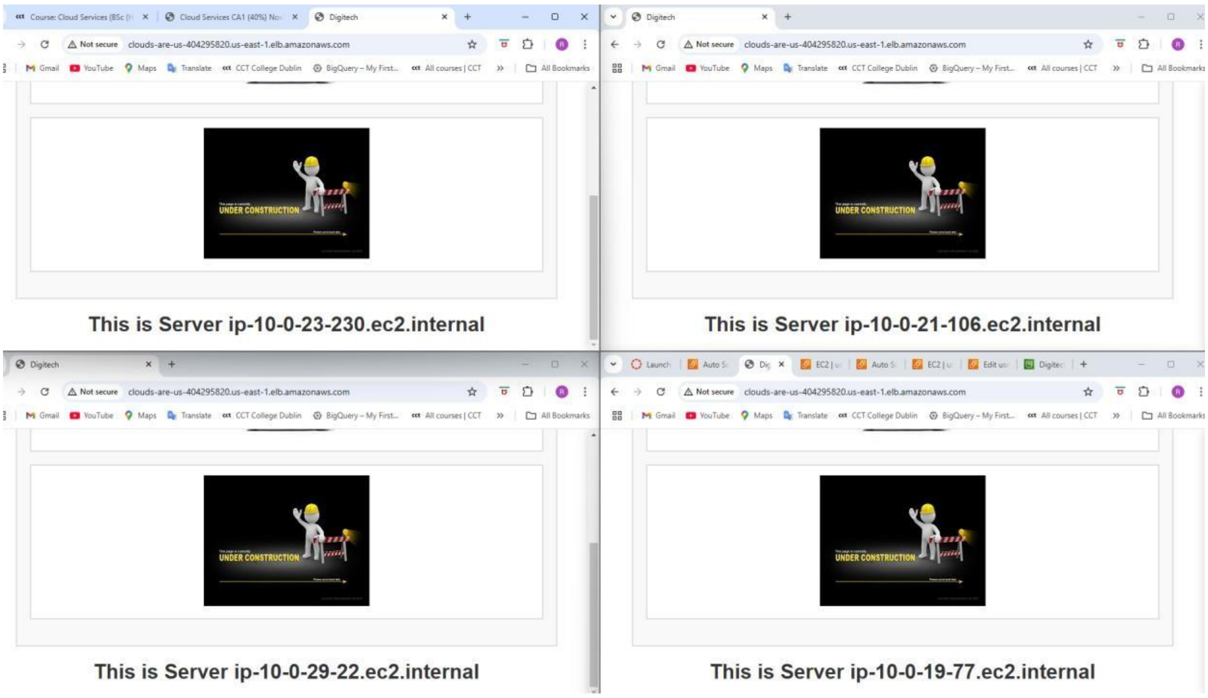
Maximum capacity
7

Desired capacity type
Units (number of instances)

Status
Updating capacity

Amazon Resource Name (ARN)
arn:aws:autoscaling:us-east-1:689698388076:autoScalingGroup:b9d7163c-2a49-4877-a16f-e51eb8c5d604:autoScalingGroupName/digitech-asg

Launch template



This is Server ip-10-0-23-230.ec2.internal

This is Server ip-10-0-21-106.ec2.internal

This is Server ip-10-0-29-22.ec2.internal

This is Server ip-10-0-19-77.ec2.internal

Benefits of integrating ASG combined with the ALB:

In this scenario, the ASG will automatically adjust the number of instances based on the current demand based on the initial configuration; the more traffic comes, the more machines the ASG will create and vice versa. The ALB will adapt to the current number of instances and distribute the traffic across the available healthy instances, ensuring each handles a reasonable amount of traffic without overusing it. If one machine does not pass the health check, the ALB will not use this instance until it is automatically (or manually) replaced by the ASG. This approach is very common in the real world; for example, an online retail company would use this combination as part of their architecture, ensuring that their application is highly scalable during peak times (Christmas, for example) to handle the unpredictable amount of traffic coming, ensuring high availability during this period. As a result, the company will make more profits by simply reducing the costs of servers running to replace them with dynamically allocated servers and optimizing their website presence, which will create more sales. Also, this will help update the website as they will introduce new offers and deals; the website will not be down when these updates are implemented. This makes integrating ASG with an ALB highly beneficial for those who use it.

Task 3b:

The DigiTech Application Load Balancer has plenty of benefits for the DigiTech application as it distributes incoming traffic across multiple application servers as long as they are available, making it essential for the application because this ensure that no single server handles too much traffic. In fact, this is used even in real life by providing different routes to reach a certain place, which will distribute the traffic (cars) among all the roads making everybody reach on time, if we only have one major route, all the cars will choose it and there will be a huge traffic jam. What makes an ALB even better is that the routes can be increased or decreased based on demands if it's combined with an Auto scaling group, so if there's a lot of demand like in

Christmas time for shopping websites, there will be as much routes as possible (based on the initial configuration) and when there's not much traffic these routes will be reduced to save costs and unused resources.

This will ensure many benefits for DigiTech such as:

- **Availability and Scalability:** As explained earlier on, this setup will ensure that the DigiTech application is highly available based on the user demands by providing enough resources to satisfy the demand, which is done by the ASG, while the ALB will ensure to divide the incoming traffic based on the resources provided by the ASG. As a result, DigiTech will always be available and provide a smooth user experience for everyone ensuring the business continuity.
- **Fault Tolerance:** The ALB, apart from the previous task, will make sure users are redirected to a healthy instance by constantly passing the instances through health check, which will let users keep using the website, and give developers enough time to fix any issues related to faulty or unhealthy instances.

By combining the ALB with the ASG, DigiTech will manage to follow some of the AWS Well- Architected framework, such as:

- **Reliability Pillar:** This Pillar focuses on creating a reliable framework that can automatically recover from failure by automatically notifying and tracking failures, also it focuses on scaling horizontally by creating multiple small resources to reduce the impact of a single failure (We talked about this in the Previous homework) and distribute requests across multiple resources and also stop guessing capacity by automatically allocating resources based on demands. As explained above, the combination of an ASG with an ALB will make sure this pillar is achieved which is highly crucial (docs.aws.amazon.com, n.d.).

- **Cost optimization Pillar:** Every business looks for reducing costs, and spending money on the cloud can be highly expensive if not planned carefully, that's why AWS highlights this pillar, which consists of reducing costs while maintaining high performance. The ASG will make sure that only needed resources are existing, The only criteria to follow here is the traffic, so during low-traffic periods the ASG will try to reduce the resources as much as possible while the ALB will distribute the traffic among all the resources, however in peak times, where most traffic usually happens we would expect the ASG to maximize the resources until the traffic goes down, this approach will reduce the cost of running instances following the model pay-as-go where the business only pays for the used resources which can help save tons of money, and this remains one of the most important reasons companies are shifting from on-premise to the cloud resources as it makes a difference over time (docs.aws.amazon.com, n.d.).

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