

# Cloud Computing CMPU3007: 2020 – 21

## Assignment 2



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Lecturer Name: Dr Basel Magableh

### **Student**

Philip Herweling

C18470774

C18470774@mytudublin.ie

TU856 Year 3

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## Introduction:

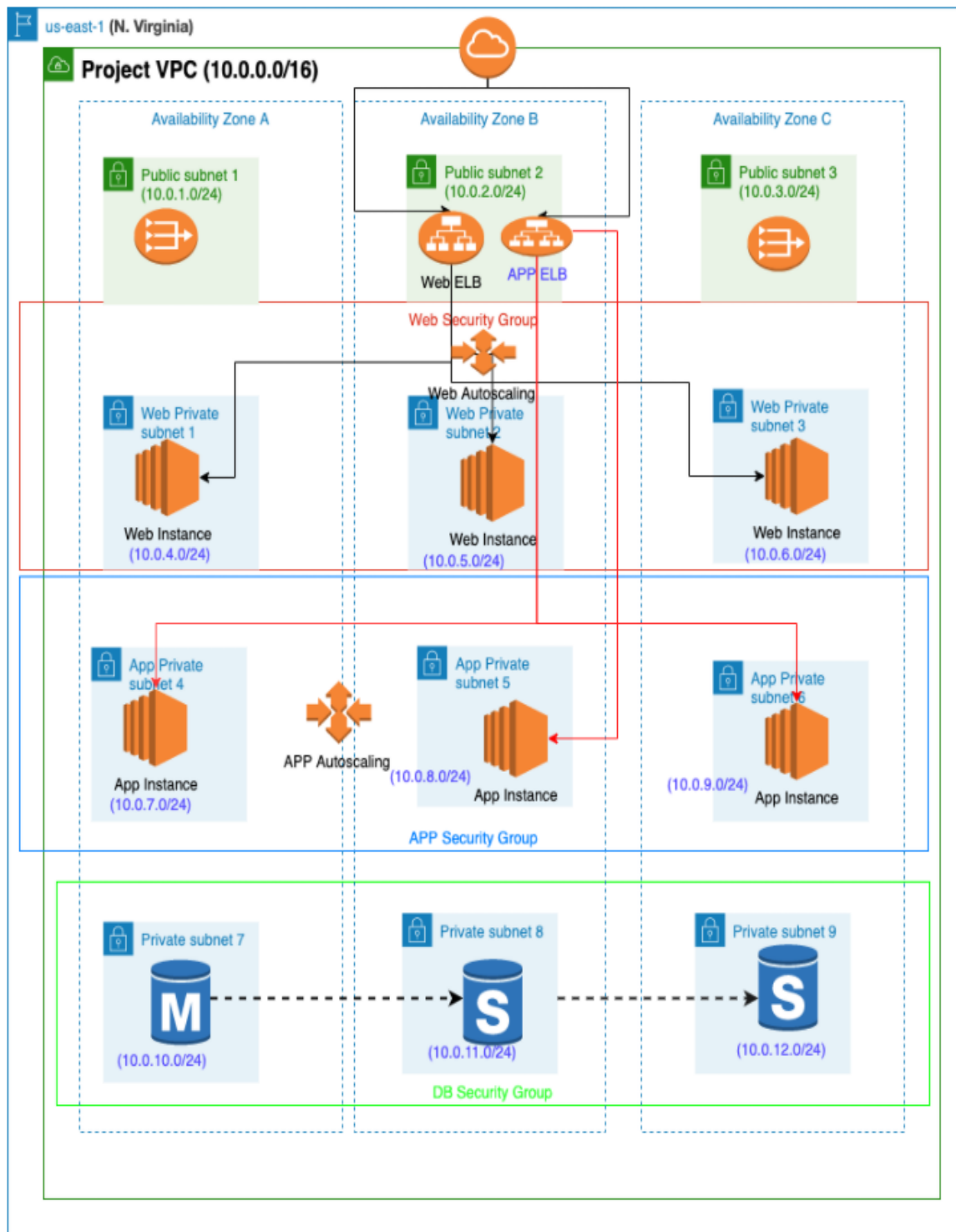
For this assignment I had to design a three-tier web application to be hosted in AWS cloud. The architecture as you can see in the figure below has a multi-AZ web server. For the assignment I started off by creating a vpc which I named `project_vpc`. The region I used was N. Virginia as specified in the brief. After making the vpc I made the 12 subnets needed i.e. the three public subnets in the three availability zones `us-east-1a`, `1b` and `1c` and the nine private subnets (three private web, database and app subnets each). These were also in the availability zones `us-east-1a`, `1b` and `1c`. After creating the subnets, I made two route tables called 'Project public route table' and 'Project private route table'. The public route table has three subnet associations which are public subnet 1, 2 and 3. And the private route table has 9 subnet associations which are all nine private subnets.

The next thing I done was create a database subnet group called `project_dp_subnet_group`. This subnet group stored all three database subnets which I created earlier. After making the database subnet group I made my database. I used MySQL to make the database.

After creating my project database, I made two EC2 instance called web tier and app server I used these when I was creating my elastic load balancers. After that then I made two AMI's one for the web tier and one for the app tier. I then needed to create two load balancers one for the app tier and one for the web tier. I called these two load balancers WebELB and AppELB. After creating the two elb's I needed to make two autoscaling groups but before I could do that, I needed to make two launch configurations first, one for the web auto scaling group and one for the app autoscaling group. After making these two launch configurations I made the two autoscaling groups.

The final step for me was to test the load balancers and make sure the connection worked. Gladly it did work, and you can find the screenshots in the section titled Required Screenshots.

## Three Tier Web application:



1. A VPC named (project\_vpc) in the (N. Virginia)

VPC:

Figure 1: project\_vpc

VPC > Your VPCs > vpc-06ac39ef8c94bfccd

vpc-06ac39ef8c94bfccd / project\_vpc

DetailsInfo

VPC ID  
vpc-06ac39ef8c94bfccd

Tenancy  
Default

Default VPC  
No

Owner ID  
043692226793

State  
Available

DHCP options set  
dopt-e8dbb692

IPv4 CIDR  
10.0.0.0/16

DNS hostnames  
Enabled

Route table  
rtb-0209838e2becd71a4

IPv6 pool  
-

DNS resolution  
Enabled

Network ACL  
acl-0ca1f9024874e28a7

IPv6 CIDR (Network border group)  
-

CIDRsFlow logsTags

IPv4 CIDRsInfo

CIDR	Status
10.0.0.0/16	Associated

IPv6 CIDRsInfo

CIDR	Pool	Status
------	------	--------

2. The web and app tiers are hosted in three availability zones (Create private subnets for each tier is recommended)

Subnets:

Figure 2: 12 subnets created

Subnets (18)Info

Filter subnets

1

Actions

Create subnet

	Name	Subnet ID	State	VPC	IPv4 CIDR	IPv6 CIDR	Available IPv4 addresses
<input type="checkbox"/>	Web Private subnet 3	subnet-0e26f7cc087ec2210	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.6.0/24	-	251
<input type="checkbox"/>	Web Private subnet 2	subnet-0a6c6310f391a40c5	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.5.0/24	-	251
<input type="checkbox"/>	Web Private subnet 1	subnet-05c95b97486231533	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.4.0/24	-	251
<input type="checkbox"/>	Public Subnet 3	subnet-072645babe644f06d	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.3.0/24	-	251
<input type="checkbox"/>	Public subnet 2	subnet-054a092a2d4a080fa	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.2.0/24	-	251
<input type="checkbox"/>	Public subnet 1	subnet-036034e206a962b22	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.1.0/24	-	250
<input type="checkbox"/>	DB Private subnet 9	subnet-0d29e823594c06f22	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.12.0/24	-	251
<input type="checkbox"/>	DB Private subnet 8	subnet-0edf6b3e6b69f6c6d	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.11.0/24	-	251
<input type="checkbox"/>	DB Private subnet 7	subnet-07dac226242f716c2	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.10.0/24	-	251
<input type="checkbox"/>	App Private subnet 6	subnet-0ae33182f07c4b1d5	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.9.0/24	-	251
<input type="checkbox"/>	App Private subnet 5	subnet-054806998444ab44f	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.8.0/24	-	251
<input type="checkbox"/>	App Private subnet 1	subnet-01e02c4cb8d336bcf	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.7.0/24	-	251
<input type="checkbox"/>	-	subnet-a185ecaf	Available	vpc-5acb0827	172.31.64.0/20	-	4091
<input type="checkbox"/>	-	subnet-f255e5ad	Available	vpc-5acb0827	172.31.32.0/20	-	4091
<input type="checkbox"/>	-	subnet-a7f84fc1	Available	vpc-5acb0827	172.31.0.0/20	-	4091
<input type="checkbox"/>	-	subnet-7cef525d	Available	vpc-5acb0827	172.31.80.0/20	-	4091
<input type="checkbox"/>	-	subnet-760c4a3b	Available	vpc-5acb0827	172.31.16.0/20	-	4091

Route Tables:

Figure 3: Project Private route table

<input type="checkbox"/>	Name	Route Table ID	Explicit subnet association	Edge associations	Main	VPC ID	Owner
<input type="checkbox"/>	Project Public route table	rtb-0c14d3f9a626ed956	3 subnets	-	No	vpc-06ac39ef8c94bfccd   ...	043692226793
<input checked="" type="checkbox"/>	Project Private route table	rtb-0209838e2becd71a4	9 subnets	-	Yes	vpc-06ac39ef8c94bfccd   ...	043692226793
<input type="checkbox"/>		rtb-d4f5baaa	-	-	Yes	vpc-5acb0827	043692226793

EDIT SUBNET ASSOCIATIONS

Subnet ID	IPv4 CIDR	IPv6 CIDR
subnet-01e02c4cb8d336bcbf   App Private subnet 1	10.0.7.0/24	-
subnet-0ae33182f07c4b1d5   App Private subnet 6	10.0.9.0/24	-
subnet-0d29e823594c06f22   DB Private subnet 9	10.0.12.0/24	-
subnet-0a6c6310f391a40c5   Web Private subnet 2	10.0.5.0/24	-
subnet-05c95b97486231533   Web Private subnet 1	10.0.4.0/24	-
subnet-054806998444ab44f   App Private subnet 5	10.0.8.0/24	-
subnet-07dac226242f716c2   DB Private subnet 7	10.0.10.0/24	-
subnet-0e26f7cc087ec2210   Web Private subnet 3	10.0.6.0/24	-
subnet-0edf6b3e6b69f6c6d   DB Private subnet 8	10.0.11.0/24	-

Figure 4: Project Public route table

Create route tableActions

Filter by tags and attributes or search by keyword

<input type="checkbox"/>	Name	Route Table ID	Explicit subnet association	Edge associations	Main	VPC ID	Owner
<input checked="" type="checkbox"/>	Project Public route table	rtb-0c14d3f9a626ed956	3 subnets	-	No	vpc-06ac39ef8c94bfccd   ...	043692226793

Route Table: rtb-0c14d3f9a626ed956

SummaryRoutesSubnet AssociationsEdge AssociationsRoute PropagationTags

Edit subnet associations

Subnet ID	IPv4 CIDR	IPv6 CIDR
subnet-072645babe644f06d   Public Subnet 3	10.0.3.0/24	-
subnet-036034e206a962b22   Public subnet 1	10.0.1.0/24	-
subnet-054a092a2d4a080fa   Public subnet 2	10.0.2.0/24	-

### 3. Host the DB in Multi AZ DB in private subnets

#### Database:

Figure 5: Database subnet group

RDS > Subnet groups > project\_dp\_subnet\_group

project\_dp\_subnet\_group

Subnet group details		
VPC ID	vpc-06ac39ef8c94bfccd	
ARN	arn:aws:rds:us-east-1:043692226793:subgrp:project_dp_subnet_group	
Description	This subnet is for the DB Multi AZ's	

Subnets (3)

Availability zone	Subnet ID	CIDR block
us-east-1c	subnet-0d29e823594c06f22	10.0.12.0/24
us-east-1a	subnet-07dac226242f716c2	10.0.10.0/24
us-east-1b	subnet-0edf6b3e6b69f6c6d	10.0.11.0/24

Figure 6: Database

RDS > Databases > project-db

project-db

Summary			
DB identifier project-db	CPU <div>0.00%</div>	Status Available	Class db.m5.xlarge
Role Instance	Current activity <div>0 Connections</div>	Engine MySQL Community	Region & AZ us-east-1b

Connectivity & security | Monitoring | Logs & events | Configuration | Maintenance & backups | Tags

Connectivity & security

Endpoint & port	Networking	Security
Endpoint project-db.cnrauf2snrws.us-east-1.rds.amazonaws.com	Availability zone us-east-1b	VPC security groups db_SecurityGroup (sg-069407e0e58fe0fd6) ( active )
Port 3306	VPC project_vpc (vpc-06ac39ef8c94bfccd)	Public accessibility No
	Subnet group project_dp_subnet_group	Certificate authority rds-ca-2019
	Subnets subnet-0edf6b3e6b69f6c6d subnet-07dac226242f716c2 subnet-0d29e823594c06f22	Certificate authority date Aug 22nd, 2024

4. Use the following script for the web tier with Amazon Linux 2

EC2 Instances:

Figure 7.1: Web Tier Instance

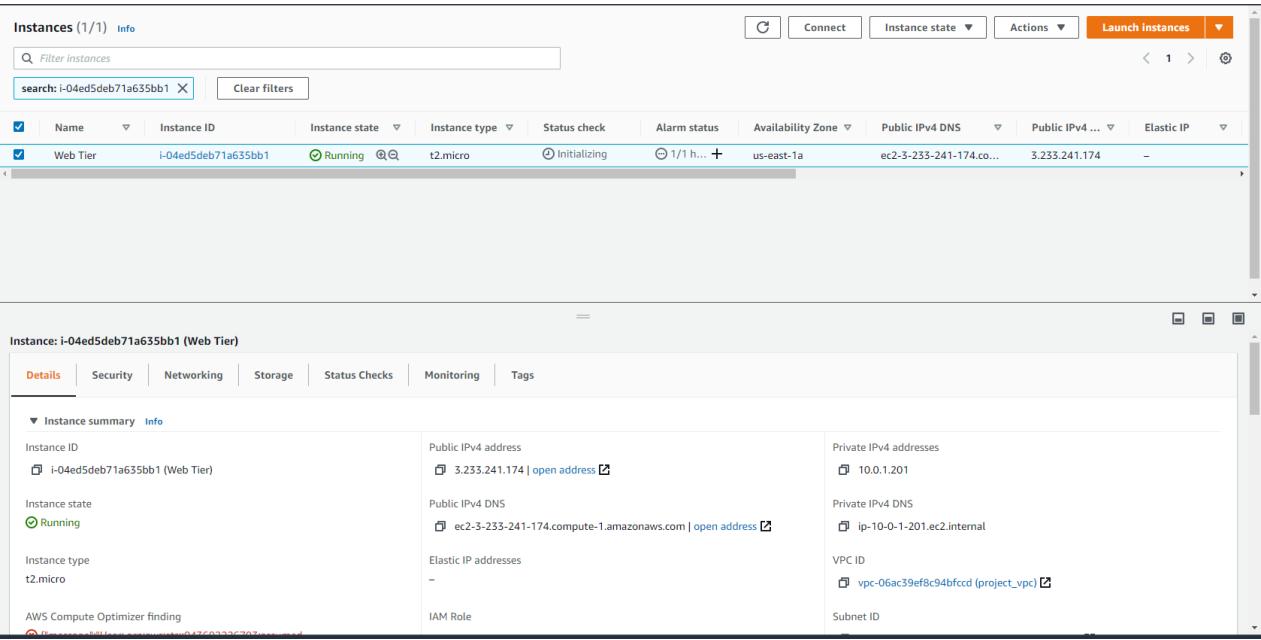
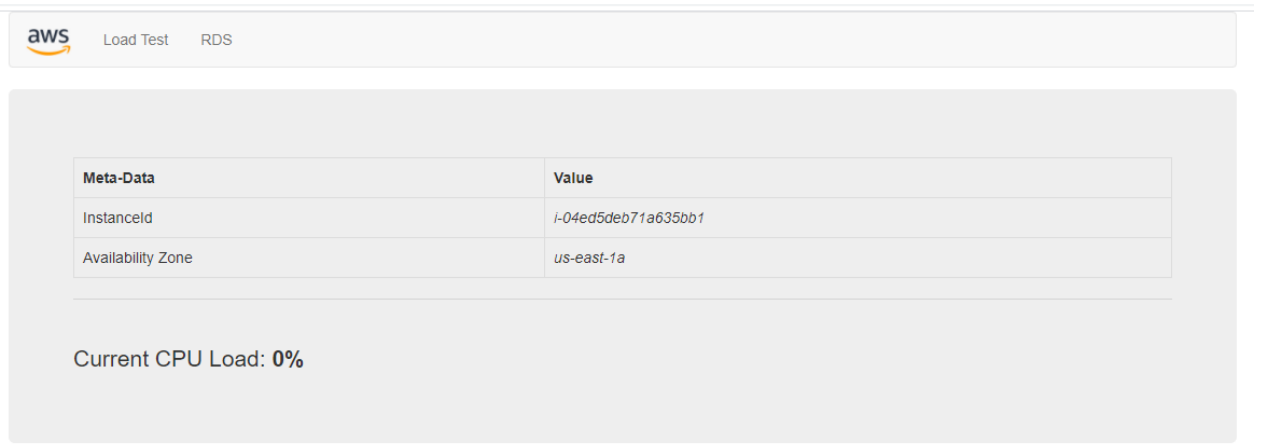


Figure 7.2:





## 5. Use Amazon Linux 2 for the app tier with the following script

Figure 8.1: App Server Instance

Instances (1/3) Info

Filter instances

< 1 >

	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...	Elastic IP
<input type="checkbox"/>	Project NAT	i-06fb774a75a20d0e6	Running	t2.nano	2/2 checks ...	2 alar... +	us-east-1a	ec2-3-221-122-16.co...	3.221.122.16	3.221.122.16
<input type="checkbox"/>	Web Tier	i-04ed5deb71a635bb1	Running	t2.micro	2/2 checks ...	2 alar... +	us-east-1a	ec2-3-233-241-174.co...	3.233.241.174	-
<input checked="" type="checkbox"/>	App Server	i-005700e138c3909f1	Running	t2.micro	2/2 checks ...	2/2 h... +	us-east-1a	ec2-3-236-196-207.co...	3.236.196.207	-

Instance: i-005700e138c3909f1 (App Server)

Details

Security

Networking

Storage

Status Checks

Monitoring

Tags

▼ Instance summary Info

Instance ID

i-005700e138c3909f1 (App Server)

Instance state

Running

Instance type

t2.micro

AWS Compute Optimizer finding

Recommendation ID: a1b2c3d4e5f6g7h8i9j0k1l2m3n4o5p6q7r8s9t0u1v2w3x4y5z6

Public IPv4 address

3.236.196.207 | open address

Public IPv4 DNS

ec2-3-236-196-207.compute-1.amazonaws.com | open address

Elastic IP addresses

-

IAM Role

Private IPv4 addresses

10.0.1.190

Private IPv4 DNS

ip-10-0-1-190.ec2.internal

VPC ID

vpc-06ac39ef8c94bfccd (project\_vpc)

Subnet ID

Figure 8.2:

aws

Load Test

RDS

Meta-Data	Value
InstanceId	i-005700e138c3909f1
Availability Zone	us-east-1a

Current CPU Load: 0%

## 6. Make Sure that the web and app tier are scalable and available

### Images:

Figure 9: Web Tier AMI and App Tier AMI

Launch EC2 Image Builder Actions											
Owned by me Filter by tags and attributes or search by keyword											
<input type="checkbox"/>	Name	AMI Name	AMI ID	Source	Owner	Visibility	Status	Creation Date	Platform	Root Device 1	Virtualization
<input type="checkbox"/>		APP Tier AMI	ami-0e3e71dfa0bbdce23	043692226793/...	043692226793	Private	available	December 19, 2020 at 9:49:...	Other Linux	ebs	hvm
<input type="checkbox"/>		WebTierAMI	ami-066df4c6715f61f3f	043692226793/...	043692226793	Private	available	December 19, 2020 at 9:45:...	Other Linux	ebs	hvm

### Snap Shots:

Figure 10: snapshots

Create Snapshot Actions									
Owned By Me Filter by tags and attributes or search by keyword									
<input type="checkbox"/>	Name	Snapshot ID	Size	Description	Status	Started	Progress	Encryption	
<input type="checkbox"/>		snap-069aa0a41c6...	8 GiB	Created by CreateImage(i-005700e138c3909f1) for ami-0e3e7...	completed	December 19, 2020 at 9:51:...	available (100%)	Not Encrypted	
<input type="checkbox"/>		snap-0a521385b56...	8 GiB	Created by CreateImage(i-04ed5deb71a635bb1) for ami-066df...	completed	December 19, 2020 at 9:46:...	available (100%)	Not Encrypted	

### Elastic load balancers

Figure 11: Web and App ELB's

Create Load Balancer Actions									
Filter by tags and attributes or search by keyword									
<input type="checkbox"/>	Name	DNS name	State	VPC ID	Availability Zones	Type	Created At	Monitoring	
<input checked="" type="checkbox"/>	AppELB	AppELB-1720553169.us-east-1.elb.amazonaws.com	provisioning	vpc-06ac39ef8c94bfccd	us-east-1a, us-east-1b,...	application	December 19, 2020 at 10:09:...		
<input type="checkbox"/>	WEBELB	WEBELB-1776923252.us-east-1.elb.amazonaws.com	active	vpc-06ac39ef8c94bfccd	us-east-1a, us-east-1b,...	application	December 19, 2020 at 10:04:...		

Load balancer: AppELB

Description

Listeners

Monitoring

Integrated services

Tags

Basic Configuration

Name

AppELB

ARN

arn:aws:elasticloadbalancing:us-east-1:043692226793:loadbalancer/app/AppELB/9bf9874a548b9515

DNS name

AppELB-1720553169.us-east-1.elb.amazonaws.com (A Record)

State

provisioning

Type

application

Scheme

internet-facing

IP address type

ipv4

Launching configurations:

Figure 12: App Tier launch configuration and Web Tier launch configuration

EC2 > Launch configurations

Launch configurations (1/2) Info

Search launch configurations

Actions Create launch configuration

	Name	AMI ID	Instance type	Spot price	Creation time
<input type="checkbox"/>	AppTierLaunchConfig	ami-0e3e71dfa0b...	t2.micro	-	Sat Dec 19 2020 22:42:58 GMT+0000 (Greenwich Mean Time)
<input checked="" type="checkbox"/>	WebTierLaunchConfig	ami-066df4c671...	t2.micro	-	Sat Dec 19 2020 22:24:27 GMT+0000 (Greenwich Mean Time)

Launch configuration: WebTierLaunchConfig

Details

Copy launch configuration

AMI ID  
ami-066df4c6715f61f3f

Kernel ID  
-

EBS optimized  
false

Create time  
Sat Dec 19 2020 22:24:27 GMT+0000 (Greenwich Mean Time)

Metadata accessible

Instance type  
t2.micro

Key name  
project

Security groups  
[sg-09a528e579ca6d519](#)

RAM disk ID  
-

Token hop limit

IAM instance profile  
-

Monitoring  
false

Spot price  
-

IP address type  
Default

Metadata version

Auto Scaling Groups:

Figure 13: App Tier Auto Scaling and Web Tier Auto Scaling Groups

EC2 > Auto Scaling groups

Auto Scaling groups (1/2)

Search your Auto Scaling groups

Edit Delete Create an Auto Scaling group

	Name	Launch template/configuration	Instances	Status	Desired capacity	Min	Max	Availability Zones
<input checked="" type="checkbox"/>	AppTierAutoScaling	AppTierLaunchConfig	2	-	2	2	6	us-east-1a, us-east-1b, us-east-1c
<input type="checkbox"/>	WebTierAutoScalingGroup	WebTierLaunchConfig	2	-	2	2	6	us-east-1a, us-east-1b, us-east-1c

Details Activity Automatic scaling Instance management Monitoring Instance refresh

Group details

Edit

Desired capacity  
2

Minimum capacity  
2

Maximum capacity  
6

Auto Scaling group name  
AppTierAutoScaling

Date created  
Sat Dec 19 2020 22:47:36 GMT+0000 (Greenwich Mean Time)

Amazon Resource Name (ARN)  
arn:aws:autoscaling:us-east-1:043692226793:autoScalingGroup:5a6a10d7-f267-4b0d-ab95-92e8c15f69f4:autoScalingGroupName/AppTierAutoScaling

EC2 Instances:

Figure 14: Instances after load test was done

Instances (11) [Info](#)

🔄

Connect

Instance state ▾

Actions ▾

Launch

🔍

Filter instances

<input type="checkbox"/>	Name ▾	Instance ID	Instance state ▾	Instance type ▾	Status check	Alarm status	Availability Zone ▾	Public IPv4 DNS ▾
<input type="checkbox"/>	Project NAT	i-06fb774a75a20d0e6	Running	t2.nano	2/2 checks ...	1 alar... +	us-east-1a	ec2-3-221-122-16.co...
<input type="checkbox"/>	Web Tier	i-04ed5deb71a635bb1	Stopped	t2.micro	–	1/1 h... +	us-east-1a	–
<input type="checkbox"/>	App Server	i-005700e138c3909f1	Stopped	t2.micro	–	1/1 h... +	us-east-1a	–
<input type="checkbox"/>	Web Auto Scaling	i-099cfc841c2d2b2bd	Running	t2.micro	2/2 checks ...	1 alar... +	us-east-1a	–
<input type="checkbox"/>	App Auto Scaling	i-06936ccdda506f5a6	Running	t2.micro	2/2 checks ...	1 alar... +	us-east-1a	–
<input type="checkbox"/>	App Auto Scaling	i-046fed469861fb5d8	Terminated	t2.micro	–	1 alar... +	us-east-1a	–
<input type="checkbox"/>	App Auto Scaling	i-05dff3ea8f2588afc	Terminated	t2.micro	–	1 alar... +	us-east-1b	–
<input type="checkbox"/>	App Auto Scaling	i-03d1ea073640cb09c	Terminated	t2.micro	–	1 alar... +	us-east-1b	–
<input type="checkbox"/>	Web Auto Scaling	i-08ce35bbe90125702	Running	t2.micro	2/2 checks ...	1 alar... +	us-east-1c	–
<input type="checkbox"/>	App Auto Scaling	i-07b72ae68ec36336f	Terminated	t2.micro	–	1 alar... +	us-east-1c	–
<input type="checkbox"/>	App Auto Scaling	i-0923d335ae28203e0	Running	t2.micro	2/2 checks ...	1 alar... +	us-east-1c	–

## 7. Required Screenshots:

### Subnets:

Subnets (18) Info

Filter subnets

< 1 > ⚙

Create subnet

<input type="checkbox"/>	Name	Subnet ID	State	VPC	IPv4 CIDR	IPv6 CIDR	Available IPv4 addresses
<input type="checkbox"/>	Web Private subnet 3	subnet-0e26f7cc087ec2210	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.6.0/24	–	250
<input type="checkbox"/>	Web Private subnet 2	subnet-0a6c6310f391a40c5	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.5.0/24	–	251
<input type="checkbox"/>	Web Private subnet 1	subnet-05c95b97486231533	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.4.0/24	–	250
<input type="checkbox"/>	Public Subnet 3	subnet-072645babe644f06d	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.3.0/24	–	249
<input type="checkbox"/>	Public subnet 2	subnet-054a092a2d4a080fa	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.2.0/24	–	250
<input type="checkbox"/>	Public subnet 1	subnet-036034e206a962b22	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.1.0/24	–	246
<input type="checkbox"/>	DB Private subnet 9	subnet-0d29e823594c06f22	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.12.0/24	–	250
<input type="checkbox"/>	DB Private subnet 8	subnet-0edf6b3e6b69f6c6d	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.11.0/24	–	250
<input type="checkbox"/>	DB Private subnet 7	subnet-07dac226242f716c2	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.10.0/24	–	251
<input type="checkbox"/>	App Private subnet 6	subnet-0ae33182f07c4b1d5	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.9.0/24	–	250
<input type="checkbox"/>	App Private subnet 5	subnet-05480699844ab44f	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.8.0/24	–	251
<input type="checkbox"/>	App Private subnet 1	subnet-01e02c4cb8d336bcf	Available	vpc-06ac39ef8c94bfccd   proje...	10.0.7.0/24	–	250

### Load Balancers:

Create Load Balancer Actions

Filter by tags and attributes or search by keyword

<input type="checkbox"/>	Name	DNS name	State	VPC ID	Availability Zones	Type	Created At	Monitoring
<input type="checkbox"/>	AppELB	AppELB-1720553169 us-eas...	active	vpc-06ac39ef8c94bfccd	us-east-1a, us-east-1b,...	application	December 19, 2020 at 10:09...	
<input checked="" type="checkbox"/>	WEBELB	WEBELB-1776923252 us-ea...	active	vpc-06ac39ef8c94bfccd	us-east-1a, us-east-1b,...	application	December 19, 2020 at 10:04...	

Load balancer: WEBELB

Description

Listeners

Monitoring

Integrated services

Tags

Basic Configuration

Name

WEBELB

ARN

arn:aws:elasticloadbalancing:us-east-1:043692226793:loadbalancer/app/WEBELB/07bd3d391390fb96

DNS name

WEBELB-1776923252 us-east-1.elb.amazonaws.com

State

active

Type

application

Scheme

internet-facing

IP address type

ipv4

Edit IP address type

# Autoscaling Groups:

EC2 > Auto Scaling groups

Auto Scaling groups (2)

🔄

Edit

Delete

Create an Auto Scaling group

🔍

Search your Auto Scaling groups

< 1 > ⚙️

<input type="checkbox"/>	Name ▾	Launch template/configuration 📄 ▾	Instances ▼	Status ▾	Desired capacity ▾	Min ▾	Max ▾	Availability Zones ▾
<input type="checkbox"/>	WebTierAutoScalingGroup	WebTierLaunchConfig	2	-	2	2	6	us-east-1a, us-east-1b, us-east-1c
<input type="checkbox"/>	AppTierAutoScaling	AppTierLaunchConfig	2	-	2	2	6	us-east-1a, us-east-1b, us-east-1c

# Final Step Showing Access:

it-1.elb.amazonaws.com/load.php

aws

Load Test

RDS

Under High CPU Load! (auto refresh in 5 seconds)

Current CPU Load: 100%

aws

Load Test

RDS

Address Book

Last name	First name	Phone	Email	Admin
				<div>Add Contact</div>
Doe	Jane	010-110-1101	<a href="#">janed@someotheraddress.org</a>	<div>Edit Remove</div>
Johnson	Roberto	123-456-7890	<a href="#">robertoj@someaddress.com</a>	<div>Edit Remove</div>