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COS20019 – Cloud Computing Architecture - Wk8: ACA Module 9 Guided Lab - Creating a Highly Available Environment

## Task 1 - Inspecting your VPC

The screenshot shows the AWS VPC dashboard with the following details:

**Left sidebar (Virtual private cloud):**

- Your VPCs (1/1) [New](#)
- Subnets
- Route tables
- Internet gateways
- Egress-only internet gateways
- Carrier gateways
- DHCP option sets
- Elastic IPs
- Managed prefix lists
- Endpoints
- Endpoint services
- NAT gateways
- Peering connections

**Top navigation:**

- Services
- Search [Alt+S]
- N. Virginia
- voclabs/user2564760=104222196@student.swin.edu.au @ 2020-5631...

**Main Content Area:**

### Your VPCs (1/1)

Name	VPC ID	State	IPv4 CIDR	IPv6 CIDR	DHCP option set	Main route table
Lab VPC	vpc-0d3aae45ce981f94f	Available	10.0.0.0/16	-	dopt-02a177e028cbc9f1	rtb-05eed9f3fd1afa7a1

**Details View for Lab VPC:**

Details			
VPC ID vpc-0d3aae45ce981f94f	State Available	DNS hostnames Enabled	DNS resolution Enabled
Tenancy Default	DHCP option set dopt-02a177e028cbc9f1	Main route table rtb-05eed9f3fd1afa7a1	Main network ACL acl-06c95d3ea774f9211
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 -	Owner ID 202056316960	

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<https://us-east-1.console.aws.amazon.com/console/home?region=us-east-1>

Steps 5-7: The Lab VPC has been set up. Its CIDR range is 10.0.0.0/16.

The screenshot shows the AWS VPC Subnets page. On the left, the navigation pane is visible with sections like VPC dashboard, EC2 Global View, Filter by VPC, Virtual private cloud, Security, and DNS firewall. In the center, the Subnets (1/4) table lists four subnets:

Name	Subnet ID	State	VPC	IPv4 CIDR	IPv6 CIDR	Available IPv4 addresses
Public Subnet 2	subnet-063edc828ecdaf7cd	Available	vpc-0d3aae45ce981f94f   Lab VPC	10.0.1.0/24	-	251
<input checked="" type="checkbox"/> Public Subnet 1	subnet-08c56dec60e59ccb6	Available	vpc-0d3aae45ce981f94f   Lab VPC	10.0.0.0/24	-	249
Private Subnet 1	subnet-03a4ce6ca30eac2ad	Available	vpc-0d3aae45ce981f94f   Lab VPC	10.0.2.0/23	-	506
Private Subnet 2	subnet-0fd3810c205320c6a	Available	vpc-0d3aae45ce981f94f   Lab VPC	10.0.4.0/23	-	507

A red arrow points from the search bar to the Public Subnet 1 row. Another red arrow points from the Public Subnet 1 row down to the Route table details below.

Below the table, the details for Public Subnet 1 are shown:

subnet-08c56dec60e59ccb6 / Public Subnet 1

Route table: rtb-0dd124c1047c8ffba / Public Route Table

Routes (2)

Destination	Target
10.0.0.0/16	local
0.0.0.0/0	igw-0e7c90543c64889a5

Steps 8-10: The route table of Public subnet 1, which resides in the Lab VPC.

The screenshot shows the AWS VPC Subnets page. A search bar at the top right contains the text "vpc-0d3aae45ce981f94f". The main table lists three subnets: "Public Subnet 2", "Public Subnet 1" (which is selected), and "Private Subnet 1". Below the table, tabs for "Details", "Flow logs", "Route table", "Network ACL" (which is highlighted in orange), "CIDR reservations", "Sharing", and "Tags" are visible.

The "Network ACL" section displays two tables: "Inbound rules (2)" and "Outbound rules (2)". Both tables have columns for Rule number, Type, Protocol, Port range, Source/Destination, and Allow/Deny. The "Allow" column is checked for all entries, while the "Deny" column is unchecked. Red arrows point from the text "At the moment, it allows all inbound and outbound traffic." to the "Allow" column in both tables.

Rule number	Type	Protocol	Port range	Source	Allow/Deny
100	All traffic	All	All	0.0.0.0/0	Allow
*	All traffic	All	All	0.0.0.0/0	Deny

Rule number	Type	Protocol	Port range	Destination	Allow/Deny
100	All traffic	All	All	0.0.0.0/0	Allow
*	All traffic	All	All	0.0.0.0/0	Deny

Step 11: The network ACL information of Public subnet 1. At the moment, it allows all inbound and outbound traffic.

The screenshot shows the AWS VPC dashboard with the 'Internet gateways' section selected. A search bar at the top contains 'search: vpc-0d3aae45ce981f94f'. The main table lists one internet gateway:

Name	Internet gateway ID	State	VPC ID	Owner
Lab IG	igw-0e7c90543c64889a5	Attached	vpc-0d3aae45ce981f94f   Lab VPC	202056316960

Two red arrows point from the left margin towards the 'Name' column of the table row for 'Lab IG'. Below the table, a detailed view for 'igw-0e7c90543c64889a5 / Lab IG' is shown, with the 'Details' tab selected. The details pane includes:

Internet gateway ID	State	VPC ID	Owner
igw-0e7c90543c64889a5	Attached	vpc-0d3aae45ce981f94f   Lab VPC	202056316960

At the bottom right of the page, there is a message: 'Activate Windows Go to Settings to activate Windows.'

Step 12: An internet gateway named Lab IG has been attached to the Lab VPC.

The screenshot shows the AWS VPC dashboard with the Security Groups page open. The search bar at the top contains "vpc-0d3aae45ce981f94f". The table lists three security groups:

Name	Security group ID	Security group name	VPC ID	Description	Owner	Inbound rules count	Outbound rules count
Inventory-App	sg-05df5be95ef88316b	Inventory-App	vpc-0d3aae45ce981f94f	Enable access to App	202056316960	0 Permission entries	1 Permission entry
-	sg-0bbb3824cb57e88dc	default	vpc-0d3aae45ce981f94f	default VPC security gr...	202056316960	1 Permission entry	1 Permission entry
Inventory-DB	sg-0673421ad9d1845cb	Inventory-DB	vpc-0d3aae45ce981f94f	Enable access to MySQL	202056316960	1 Permission entry	1 Permission entry

The "Inventory-DB" row is highlighted with a blue background. Below the table, the title "sg-0673421ad9d1845cb - Inventory-DB" is displayed. The "Inbound rules" tab is selected. A message says "You can now check network connectivity with Reachability Analyzer" with a "Run Reachability Analyzer" button. The "Inbound rules (1/1)" table shows one rule:

Name	Security group rule...	IP version	Type	Protocol	Port range	Source	Description
-	sgr-0b7bbe4a1ebc99fbf	IPv4	MySQL/Aurora	TCP	3306	10.0.0.0/16	-

Red arrows point from the left margin to the "Inventory-DB" row in the table and from the left margin to the "Inbound rules" section.

Steps 13-15: The security group Inventory-DB allows inbound MySQL traffic from anywhere in the VPC.

The screenshot shows the AWS VPC dashboard with the 'Security groups' section selected. A search bar at the top right contains the text 'search: sg-0673421ad9d1845cb'. The main table lists three security groups:

Name	Security group ID	Security group name	VPC ID	Description	Owner	Inbound rules count	Outbound rules count
Inventory-App	sg-05df5be95ef88316b	Inventory-App	vpc-0d3aae45ce981f94f	Enable access to App	202056316960	0 Permission entries	1 Permission entry
-	sg-0bbb3824cb57e88dc	default	vpc-0d3aae45ce981f94f	default VPC security gr...	202056316960	1 Permission entry	1 Permission entry
<b>Inventory-DB</b>	<b>sg-0673421ad9d1845cb</b>	<b>Inventory-DB</b>	<b>vpc-0d3aae45ce981f94f</b>	<b>Enable access to MySQL</b>	<b>202056316960</b>	<b>1 Permission entry</b>	<b>1 Permission entry</b>

Below the table, a modal window for the 'Inventory-DB' security group is open, specifically the 'Outbound rules' tab. It displays one rule:

Name	Security group rule...	IP version	Type	Protocol	Port range	Destination	Description
-	sgr-001713cc1b1985f8c	IPv4	All traffic	All	All	0.0.0/0	-

A red arrow points from the text 'Step 16: The security group allows all outbound traffic.' to the 'Destination' field in the table.

Step 16: The security group allows all outbound traffic.

## Task 2 – Creating an application load balancer

The screenshot shows the 'Create security group' page in the AWS Management Console. The 'Basic details' section includes a 'Security group name' field with 'Inventory-LB' and a 'Description' field with 'Enable web access to load balancer'. The 'VPC' dropdown is set to 'vpc-0d3aae45ce981f94f'. The 'Inbound rules' section contains two entries:

Type	Protocol	Port range	Source	Description - optional
HTTP	TCP	80	Anywhere- 0.0.0.0/0	
HTTPS	TCP	443	Anywhere- 0.0.0.0/0	

Red arrows highlight the 'Type' dropdown for the first rule and the 'Source' field for both rules.

Steps 25-28: Create a new security group that allows all HTTP/HTTPS traffic to the load balancer.

**Specify group details**

Your load balancer routes requests to the targets in a target group and performs health checks on the targets.

**Basic configuration**

Settings in this section can't be changed after the target group is created.

**Choose a target type**

Instances

- Supports load balancing to instances within a specific VPC.
- Facilitates the use of Amazon EC2 Auto Scaling [\[?\]](#) to manage and scale your EC2 capacity.

IP addresses

- Supports load balancing to VPC and on-premises resources.
- Facilitates routing to multiple IP addresses and network interfaces on the same instance.
- Offers flexibility with microservice based architectures, simplifying inter-application communication.
- Supports IPv6 targets, enabling end-to-end IPv6 communication, and IPv4-to-IPv6 NAT.

Lambda function

- Facilitates routing to a single Lambda function.
- Accessible to Application Load Balancers only.

Application Load Balancer

- Offers the flexibility for a Network Load Balancer to accept and route TCP requests within a specific VPC.
- Facilitates using static IP addresses and PrivateLink with an Application Load Balancer.

**Target group name**

Inventory-App

A maximum of 32 alphanumeric characters including hyphens are allowed, but the name must not begin or end with a hyphen.

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Step 31: Create a target group for the load balancer.

The screenshot shows the AWS CloudFront 'Create Target Group' configuration page. At the top, the port is set to 80. In the 'VPC' section, a red arrow points to the 'Lab VPC' entry, which includes the VPC ID (vpc-0d5aae45ce981f94f) and IP range (IPv4: 10.0.0.0/16). Below this, the 'Protocol version' section shows 'HTTP1' selected. In the 'Health checks' section, the protocol is set to 'HTTP' and the path is '/'. A 'Restore defaults' button is visible. The bottom right corner features a Windows activation message.

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Step 31: Create a target group for the load balancer. (continued)

The screenshot shows the 'Advanced health check settings' configuration page in the AWS CloudFront console. The 'Health check port' section is visible, showing the default 'Traffic port' selected. The 'Healthy threshold' is set to 2, and the 'Unhealthy threshold' is also set to 2. The 'Timeout' is set to 5 seconds, and the 'Interval' is set to 10 seconds. The 'Success codes' input field contains the value 200. A red arrow points to the 'Interval' input field.

Advanced health check settings

Health check port

Traffic port

Override

Healthy threshold

Unhealthy threshold

Timeout

Interval

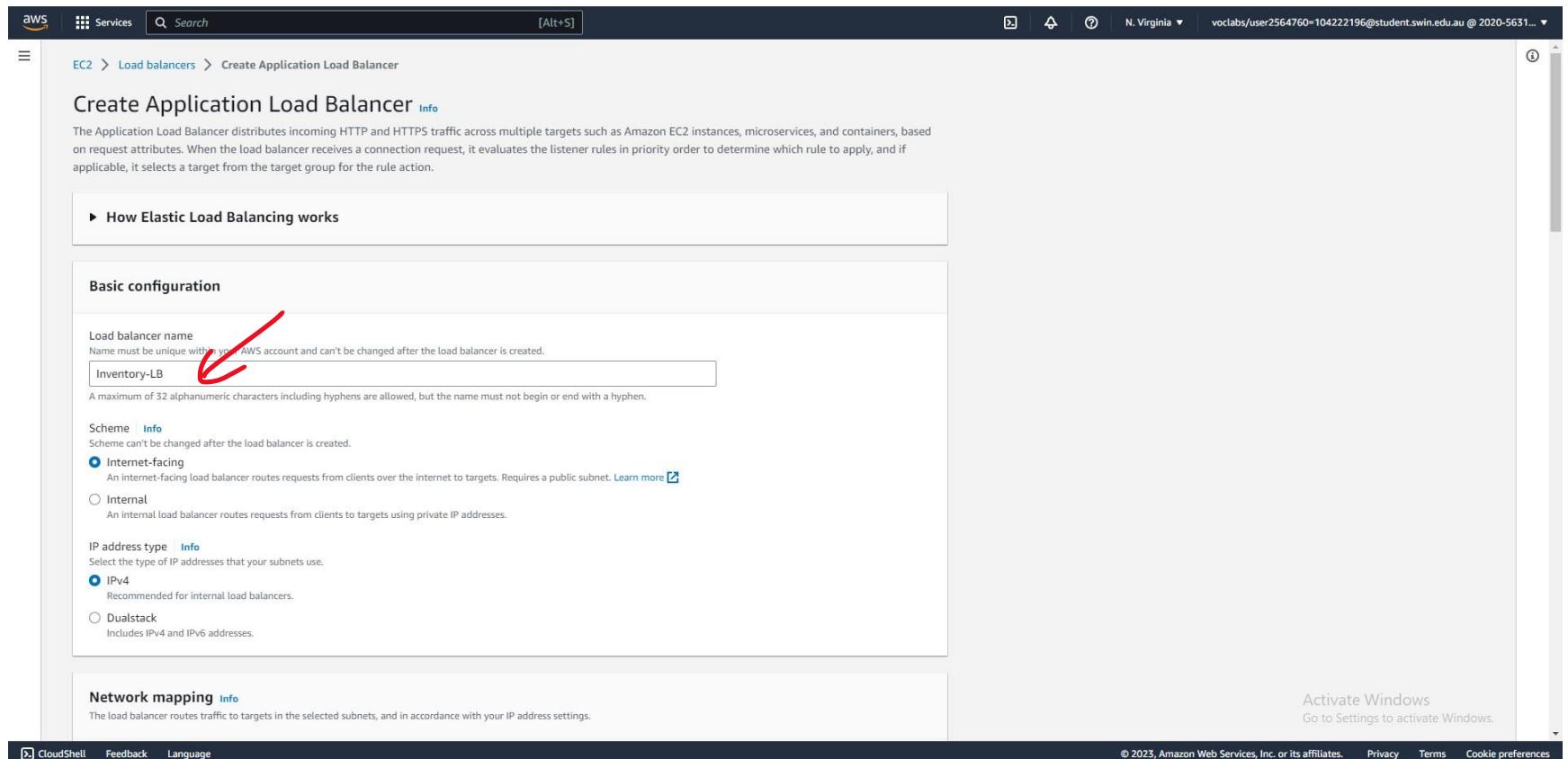
Success codes

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Step 31: Create a target group for the load balancer. (continued)



The screenshot shows the AWS CloudFormation console interface. The top navigation bar includes the AWS logo, a services menu, a search bar, and account information. The main content area is titled "Create Stack" and displays the "Basic Information" step. A red arrow points to the "Template URL" input field, which contains the URL: <https://s3.amazonaws.com/vocabs/Inventory-Stack.yaml>. Below the input field, there is explanatory text: "The template must be a valid CloudFormation template. You can upload a local file or enter a URL to an S3 bucket." The "Next Step" button is visible at the bottom right.

Steps 17-21: Create an application load balancer (set the name to Inventory-LB)

Screenshot of the AWS Network mapping configuration page. A red arrow points to the 'Lab VPC' dropdown menu, which shows 'Lab VPC' selected with the value 'vpc-0d3aae45ce981f94f' and 'IPv4: 10.0.0.0/16'. Another red arrow points to the 'Public Subnet 1' dropdown menu, which shows 'subnet-08c56dec60e59ccb6' selected. A third red arrow points to the 'Public Subnet 2' dropdown menu, which shows 'subnet-063edc828ecdaf7cd' selected.

Network mapping [Info](#)  
The load balancer routes traffic to targets in the selected subnets, and in accordance with your IP address settings.

VPC [Info](#)  
Select the virtual private cloud (VPC) for your targets or you can [create a new VPC](#). Only VPCs with an internet gateway are enabled for selection. The selected VPC can't be changed after the load balancer is created. To confirm the VPC for your targets, view your target groups.

Lab VPC  
vpc-0d3aae45ce981f94f  
IPv4: 10.0.0.0/16

Mappings [Info](#)  
Select at least two Availability Zones and one subnet per zone. The load balancer routes traffic to targets in these Availability Zones only. Availability Zones that are not supported by the load balancer or the VPC are not available for selection.

us-east-1a (use1-az6)

Subnet  
subnet-08c56dec60e59ccb6 Public Subnet 1

IPv4 address  
Assigned by AWS

us-east-1b (use1-az1)

Subnet  
subnet-063edc828ecdaf7cd Public Subnet 2

IPv4 address  
Assigned by AWS

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Steps 22-24: Create an application load balancer (select the Lab VPC and the two public subnets)

**Security groups** [Info](#)

A security group is a set of firewall rules that control the traffic to your load balancer. Select an existing security group, or you can create a new security group [Create new security group](#).

Security groups

Select up to 5 security groups

Inventory-LB sg-077f5e5b37bbdd8f6 X  
VPC vpc-0d5aae45ce981f94f

**Listeners and routing** [Info](#)

A listener is a process that checks for connection requests using the port and protocol you configure. The rules that you define for a listener determine how the load balancer routes requests to its registered targets.

▼ Listener HTTP:80

Protocol Port Default action [Info](#)

HTTP : 80 Forward to [Inventory-App](#) Target type: Instance, IPv4

Remove Create target group [Create target group](#)

Listener tags - optional

Consider adding tags to your listener. Tags enable you to categorize your AWS resources so you can more easily manage them.

Add listener tag You can add up to 50 more tags.

Add listener

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Step 29, 34: Create an application load balancer (assign the Inventory-LB security group and forward HTTP traffic to the Inventory-App group.)

## Task 3 - Creating an Auto Scaling group

The screenshot shows the 'Create image' wizard in the AWS EC2 console. The instance ID is 'i-00501b164a0c4400a (Web Server 1)'. A red arrow points to the 'Image name' field, which contains 'Web Server AMI'. The 'Image description - optional' field contains 'Lab AMI for Web Server'. Under 'No reboot', the 'Enable' checkbox is unchecked. In the 'Instance volumes' section, there is one volume listed: an EBS volume of size 8 GiB, type General Purpose S., IOPS 100, Throughput 100, Delete on termination checked, and Encrypted checked. The 'Add volume' button is visible. A note says 'During the image creation process, Amazon EC2 creates a snapshot of each of the above volumes.' In the 'Tags - optional' section, the 'Tag image and snapshots together' radio button is selected. The bottom right corner shows 'Activate Windows Go to Settings to activate Windows.'

Steps 36-41: Create an AMI from the Web Server.

The screenshot shows the AWS EC2 'Create launch template' wizard. The left panel displays the 'Launch template name and description' section, where the 'Launch template name - required' field contains 'Inventory-LT'. A red arrow points to this field. Below it, the 'Template version description' field contains 'A prod webserver for MyApp'. Another red arrow points to the 'Provide guidance to help me set up a template that I can use with EC2 Auto Scaling' checkbox, which is checked. The right panel shows the 'Summary' section with the following details:

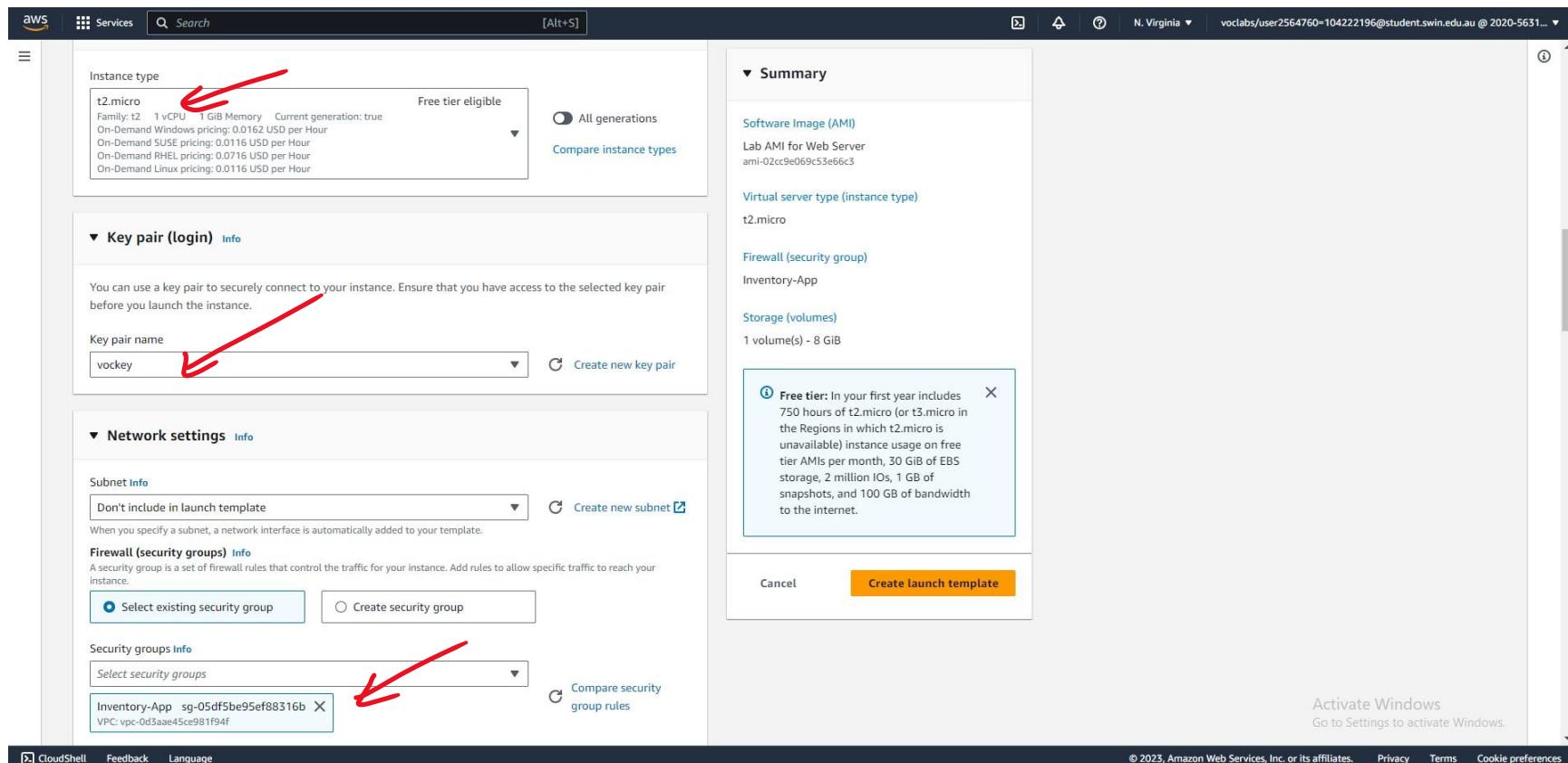
- Software Image (AMI):** Lab AMI for Web Server ami-02cc9e069c53e66c3
- Virtual server type (instance type):** t2.micro
- Firewall (security group):** Inventory-App
- Storage (volumes):** 1 volume(s) - 8 GiB

A tooltip for the 'Free tier' is visible, stating: 'Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per month, 30 GiB of EBS storage, 2 million I/Os, 1 GB of snapshots, and 100 GB of bandwidth to the internet.' The bottom right of the summary panel features a 'Create launch template' button.

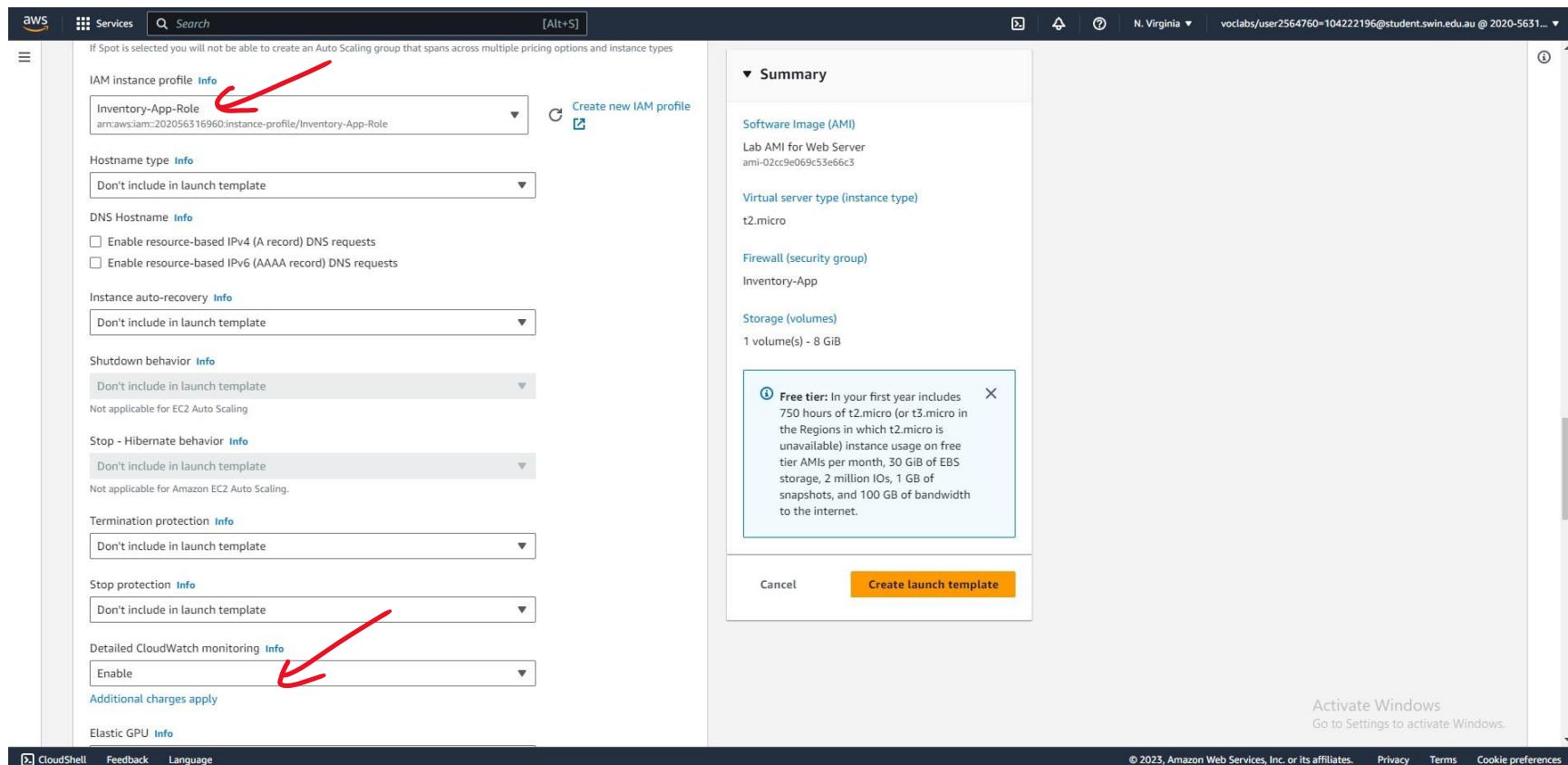
Steps 42-44: Create a launch template (set the name to Inventory-LT and select provide guidance for Auto-scaling)

The screenshot shows the AWS Launch Template creation interface. On the left, under 'Application and OS Images (Amazon Machine Image) - required', a red arrow points to the 'Owned by me' tab where a 'Web Server AMI' is selected. This AMI is described as 'Lab AMI for Web Server'. Below it, the 'Instance type' section is visible. On the right, the 'Summary' pane shows the chosen configuration: 'Software Image (AMI)' is 'Lab AMI for Web Server' (ami-02cc9e069c53e66c3), 'Virtual server type (instance type)' is 't2.micro', and 'Storage (volumes)' is '1 volume(s) - 8 GiB'. A tooltip for the 'Free tier' is displayed, stating: 'Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per month, 30 GiB of EBS storage, 2 million I/Os, 1 GB of snapshots, and 100 GB of bandwidth to the internet.' At the bottom right of the summary pane is a prominent orange 'Create launch template' button.

Step 44: Create a launch template (select the Web Server AMI)



Step 44: Create a launch template (choose the t2.micro instance type, vokey key pair, and Inventory-App security group)



Step 44: Create a launch template (assign the Inventory-App-Role AMI role and enable detailed CloudWatch monitoring).

The screenshot shows the AWS CloudFormation console interface for creating a launch template. The left panel contains configuration options for metadata transport, version, response hop limit, and tags. The right panel displays the summary of the launch template, including the software image (Lab AMI for Web Server), virtual server type (t2.micro), firewall (Inventory-App), and storage (1 volume(s) - 8 GiB). A modal window titled 'Free tier' provides information about the free tier benefits. At the bottom, there is a 'Create launch template' button.

Don't include in launch template

Metadata transport  
Don't include in launch template

Metadata version [Info](#)  
Don't include in launch template

Metadata response hop limit [Info](#)  
Don't include in launch template

Allow tags in metadata [Info](#)  
Don't include in launch template

User data - optional [Info](#)  
Upload a file with your user data or enter it in the field.

```
#!/bin/bash
# Install Apache Web Server and PHP
yum install -y httpd mysql
amazon-linux-extras install -y php7.2
# Download Lab files
wget https://aws-tc-largeobjects.s3-us-west-2.amazonaws.com/ILT-TF-200-ACACAD-20-EN/mod9-guided/scripts/inventory-app.zip
unzip inventory-app.zip -d /var/www/html/
# Download and install the AWS SDK for PHP
wget https://github.com/aws/aws-sdk-php/releases/download/3.62.3/aws.zip
unzip aws -d /var/www/html/
# Turn on web server
chkconfig httpd on
service httpd start
```

User data has already been base64 encoded

Summary

Software Image (AMI)  
Lab AMI for Web Server  
ami-02cc9e069c53e66c3

Virtual server type (instance type)  
t2.micro

Firewall (security group)  
Inventory-App

Storage (volumes)  
1 volume(s) - 8 GiB

**Free tier:** In your first year includes  
750 hours of t2.micro (or t3.micro in  
the Regions in which t2.micro is  
unavailable) instance usage on free  
tier AMIs per month, 30 GiB of EBS  
storage, 2 million I/Os, 1 GB of  
snapshots, and 100 GB of bandwidth  
to the internet.

Create launch template

Steps 44-45: Create a launch template (add user data and confirm creation).

The screenshot shows the AWS EC2 Auto Scaling 'Create Auto Scaling group' wizard, Step 1: Choose launch template. The 'Name' field is filled with 'Inventory-ASG' and has a red arrow pointing to it. The 'Launch template' dropdown is set to 'Inventory-LT' and has another red arrow pointing to it. The 'Description' field is empty. The 'Launch template' section shows 'Inventory-LT' and 'lt-0eb7b80526cd9670'. The 'Instance type' is listed as 't2.micro'. A note at the top states: 'For accounts created after May 31, 2023, the EC2 console only supports creating Auto Scaling groups with launch templates. Creating Auto Scaling groups with launch configurations is not recommended but still available via the CLI and API until December 31, 2023.'

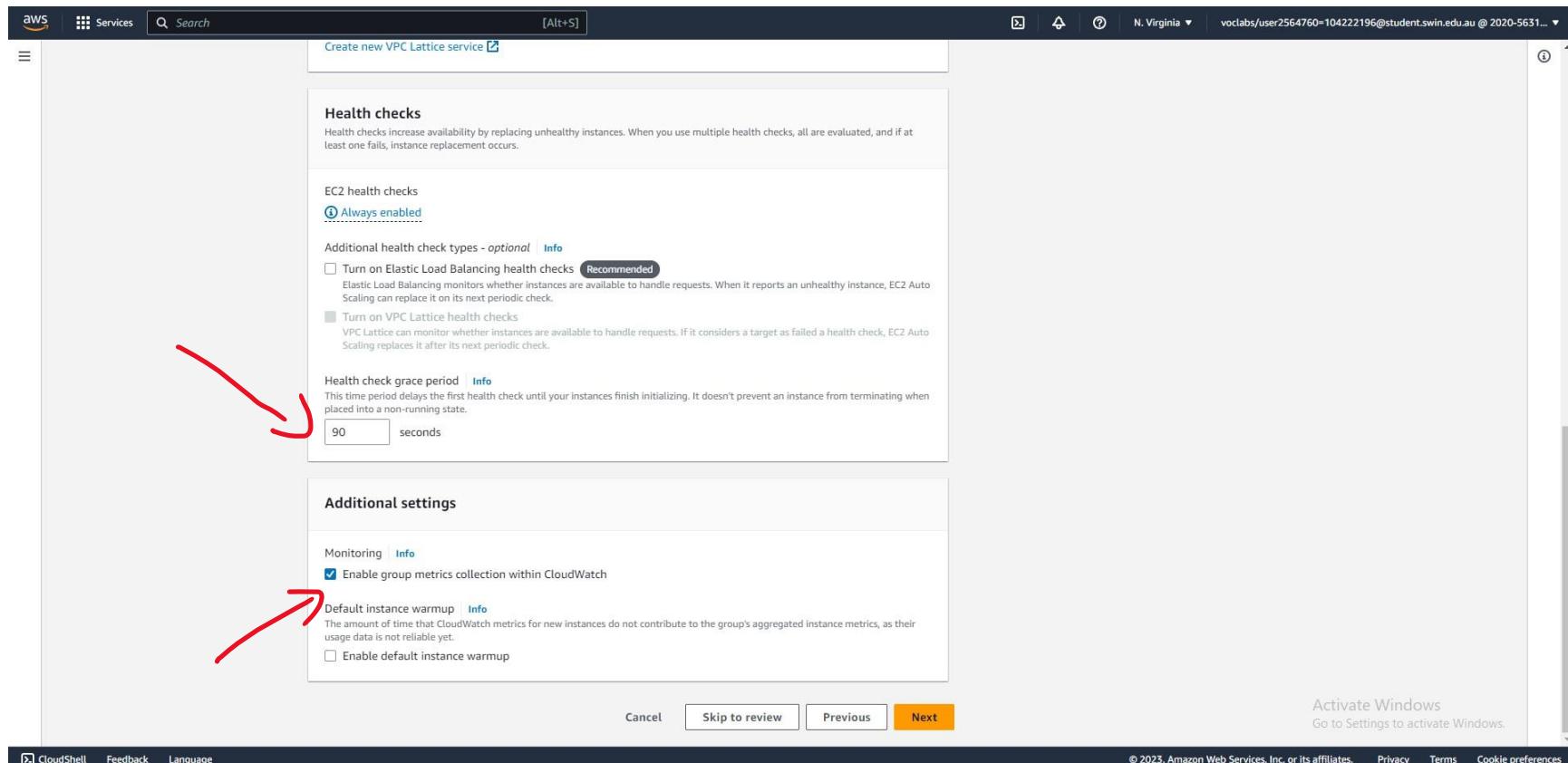
Steps 46-47: Create an auto-scaling group from the launch template (step 1 – set a name and confirm the correct launch template is selected)

The screenshot shows the 'Choose instance launch options' step of the AWS Auto Scaling group creation wizard. On the left, a sidebar lists steps 1 through 7. Step 2, 'Choose instance launch options', is selected. The main area shows the 'Network' configuration. It includes a note about using multiple Availability Zones and a 'VPC' dropdown set to 'vpc-0d3aae45ce981f94f (Lab VPC) 10.0.0.0/16'. Below this is a 'Create a VPC' button. The 'Availability Zones and subnets' section contains two entries: 'us-east-1a | subnet-03a4ce6ca30eac2ad (Private Subnet 1) 10.0.2.0/23' and 'us-east-1b | subnet-0fd3810c205320c6a (Private Subnet 2) 10.0.4.0/23'. A 'Create a subnet' button is also present. At the bottom, there's an 'Instance type requirements' section with an 'Override launch template' button. The status bar at the bottom right shows 'Activate Windows Go to Settings to activate Windows.'

Step 48: Create an auto-scaling group (step 2 – choose to launch instances into the private subnets of the Lab VPC).

The screenshot shows the AWS Auto Scaling Groups 'Create Auto Scaling group' wizard at Step 3 - optional. The left sidebar lists steps from 1 to 7. The main area is titled 'Configure advanced options - optional'. It describes integrating the Auto Scaling group with other services like VPC Lattice or load balancers. The 'Load balancing' section is highlighted with a red arrow pointing to the 'Attach to an existing load balancer' radio button. Another red arrow points to the 'Select target groups' dropdown, which shows a single item: 'Inventory-App | HTTP Application Load Balancer: Inventory-LB'.

Step 49: Create an auto-scaling group from the launch template (step 3 – attach the group to an existing load balancer)



Step 49: Create an auto-scaling group from the launch template (step 3 – modify the health check grace period and enable group metrics collection).

The screenshot shows the AWS Management Console interface for creating an Auto Scaling group. The top navigation bar includes the AWS logo, a services menu, a search bar, and account information. The main content area is titled "Configure group size and scaling policies - optional". On the left, a vertical sidebar lists steps from 1 to 7, with "Step 4 - optional" currently selected. The main panel has two sections: "Group size - optional" and "Scaling policies - optional". In the "Group size" section, the "Desired capacity" is set to 2, and both "Minimum capacity" and "Maximum capacity" are also set to 2. In the "Scaling policies" section, the "None" option is selected. Red arrows highlight the "Minimum capacity" field and the "None" scaling policy selection.

Step 50: Create an auto-scaling group from the launch template (step 4 – set the group size and group scaling policy)

Screenshot of the AWS CloudFormation console showing the "Create Auto Scaling group" wizard, Step 6: Add tags - optional.

The left sidebar shows the steps:

- Step 1: Choose launch template
- Step 2: Choose instance launch options
- Step 3 - optional: Configure advanced options
- Step 4 - optional: Configure group size and scaling policies
- Step 5 - optional: Add notifications
- Step 6 - optional: Add tags
- Step 7: Review

The main content area displays the "Add tags - optional" section with an info message:

You can optionally choose to add tags to instances (and their attached EBS volumes) by specifying tags in your launch template. We recommend caution, however, because the tag values for instances from your launch template will be overridden if there are any duplicate keys specified for the Auto Scaling group.

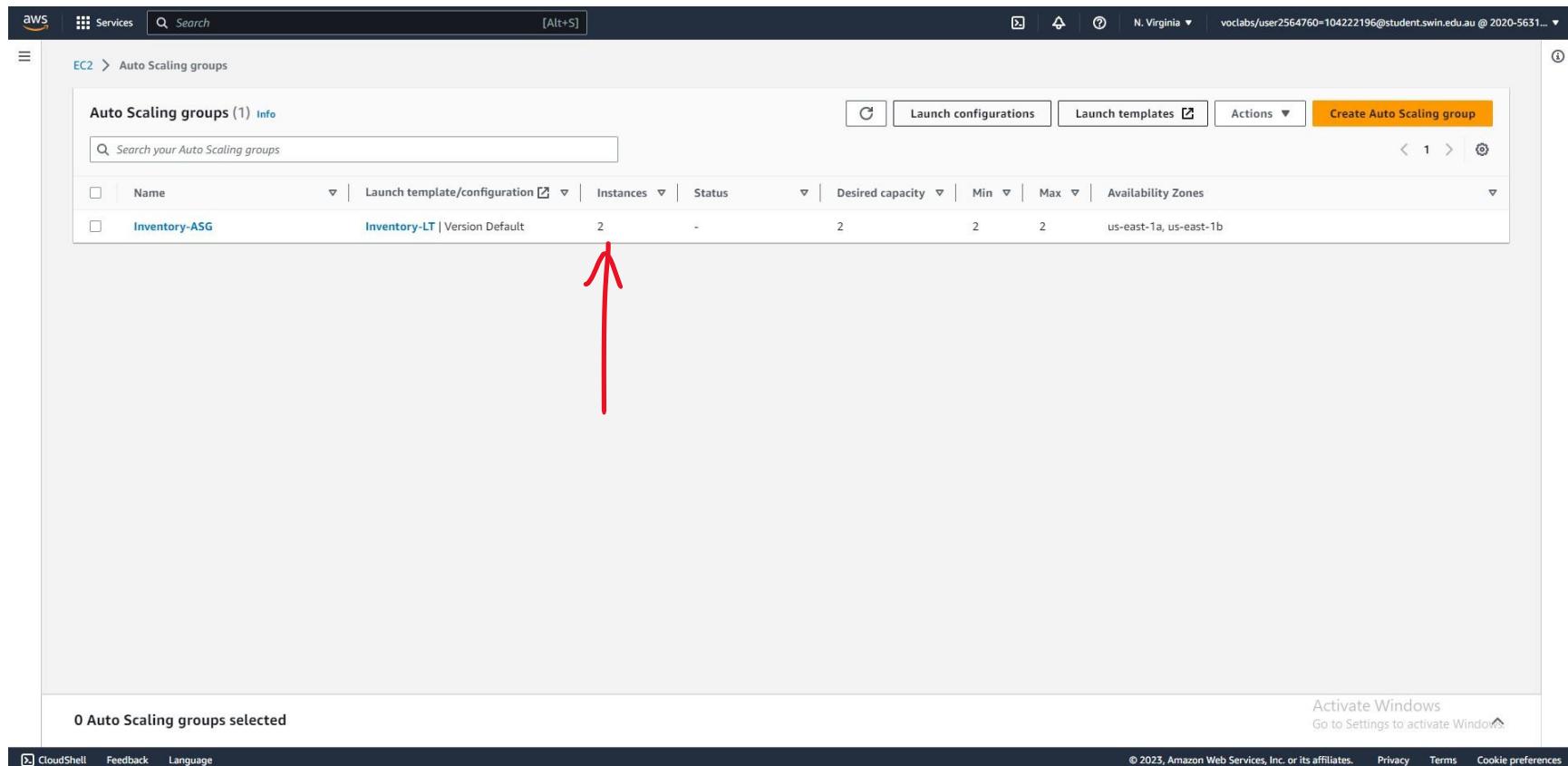
A red arrow points to the "Add tag" button, which is highlighted in yellow.

Below the tags table, there are "Cancel", "Previous", and "Next" buttons. The "Next" button is highlighted in orange.

At the bottom right, there is an "Activate Windows" message: "Activate Windows Go to Settings to activate Windows."

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Step 51-52: Create an auto-scaling group from the launch template (skip step 5 – add notifications, add a name tag in step 6)



A screenshot of the AWS Management Console showing the Auto Scaling groups page. The page title is "Auto Scaling groups (1) Info". There is a search bar labeled "Search your Auto Scaling groups". The main table has columns: Name, Launch template/configuration, Instances, Status, Desired capacity, Min, Max, and Availability Zones. One row is visible for "Inventory-ASG" with "Inventory-LT | Version Default" as the launch template, "2" instances, and "us-east-1a, us-east-1b" as availability zones. A red arrow points upwards from the bottom of the table towards the "Desired capacity" column. At the bottom left, it says "0 Auto Scaling groups selected". At the bottom right, there are links for "Activate Windows", "Go to Settings to activate Windows", "CloudShell", "Feedback", "Language", "© 2023, Amazon Web Services, Inc. or its affiliates.", "Privacy", "Terms", and "Cookie preferences".

Name	Launch template/configuration	Instances	Status	Desired capacity	Min	Max	Availability Zones
Inventory-ASG	Inventory-LT   Version Default	2	-	2	2	2	us-east-1a, us-east-1b

Step 53: After a few minutes, two instances will be launched by the auto-scaling group.

The screenshot shows the AWS Auto Scaling Groups page. At the top, a green banner displays the message: "Inventory-ASG created successfully. Group metrics collection is enabled." Below the banner, the page title is "Auto Scaling groups" under the EC2 navigation menu. A search bar is present above the main table. The table has columns: Name, Launch template/configuration, Instances, Status, Desired capacity, Min, Max, and Availability Zones. One row is visible for "Inventory-ASG", which uses the "Inventory-LT" launch template, has 0 instances, and is in the status "Updating capacity...". Two red arrows point from the text "Step 53: After creating the auto-scaling group, it will start with 0 instances." to the "Instances" column value of 0 and the "Status" column text "Updating capacity...".

Name	Launch template/configuration	Instances	Status	Desired capacity	Min	Max	Availability Zones
Inventory-ASG	Inventory-LT   Version Default	0	Updating capacity...	2	2	2	us-east-1a, us-east-1b

Step 53: After creating the auto-scaling group, it will start with 0 instances.

## Task 4 - Updating security groups

The screenshot shows the 'Edit inbound rules' page for a security group named 'sg-05df5be95ef88316b - Inventory-App'. The 'Inbound rules' table has one row:

Security group rule ID	Type	Protocol	Port range	Source	Description - optional
-	HTTP	TCP	80	Custom	sg-077f5e5b37bbdd8f6 X

Buttons at the bottom right include 'Add rule', 'Cancel', 'Preview changes', and 'Save rules'. A red arrow points from the 'Source' dropdown to the 'Custom' option.

Steps 54-58: Add a rule to the Application security group that allows all HTTP traffic from the load balancer.

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EC2 > Security Groups > sg-0673421ad9d1845cb - Inventory-DB > Edit inbound rules

## Edit inbound rules Info

Inbound rules control the incoming traffic that's allowed to reach the instance.

Security group rule ID	Type <small>Info</small>	Protocol <small>Info</small>	Port range <small>Info</small>	Source <small>Info</small>	Description - optional <small>Info</small>
-	MySQL/Aurora	TCP	3306	Custom	sg-05df5be95ef88316b X

Add rule Cancel Preview changes Save rules

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Steps 59-60: Add a rule to the Database security group that allows all inbound MySQL traffic from the Application servers.

## Task 5 - Testing the application

The screenshot shows the AWS EC2 Target Groups console. On the left, a navigation sidebar lists various services like Launch Templates, Spot Requests, and Auto Scaling. The main area shows a table of target groups, with one named "Inventory-App" selected. A red arrow points from the text below to the "Targets" tab of the "Target group: Inventory-App" details page, which displays two healthy instances.

**Target groups (1/1) Info**

Name	ARN	Port	Protocol	Target type	Load balancer	VPC ID
Inventory-App	arn:aws:elasticloadbalancing:us-east-1:123456789012:targetgroup/Inventory-App/5678901234567890	80	HTTP	Instance	Inventory-LB	vpc-0d3aae45ce981f94f

**Target group: Inventory-App**

Registered targets (2)

Instance ID	Name	Port	Zone	Health status	Health status details
i-01b4e26bf24c38946	Inventory-App	80	us-east-1a	healthy	
i-0264a7cce63fa4977	Inventory-App	80	us-east-1b	healthy	

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Steps 61-64: Two healthy instances are in the target group.

The screenshot shows the AWS Elastic Load Balancing (ELB) service in the EC2 section. On the left, there's a navigation sidebar with links for Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Scheduled Instances, 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), and Auto Scaling (Auto Scaling Groups). The main area displays a table titled 'Load balancers (1/1)' with one entry: 'Inventory-LB'. The table includes columns for Name, DNS name, State, VPC ID, Availability Zones, Type, and Date created. Below this, a detailed view of the 'Inventory-LB' load balancer is shown under the heading 'Load balancer: Inventory-LB'. The 'Details' tab is selected, showing fields for Load balancer type (Application), Status (Active), Scheme (Internet-facing), Hosted zone (Z35SXDOTRQ7X7K), VPC (vpc-0d3aae45ce981f94f), Availability Zones (subnet-08c56dec60e59ccb6, subnet-063edc828ecdaf7cd), IP address type (IPv4), Date created (July 2, 2023, 16:12 (UTC+07:00)), and DNS name (Inventory-LB-1761013538.us-east-1.elb.amazonaws.com (A Record)). A red arrow points from the text instructions to the 'DNS name' field.

Name	DNS name	State	VPC ID	Availability Zones	Type	Date created
Inventory-LB	Inventory-LB-1761013538...	Active	vpc-0d3aae45ce981f94f	2 Availability Zones	application	July 2, 2023, 16:12 (UTC+07:00)

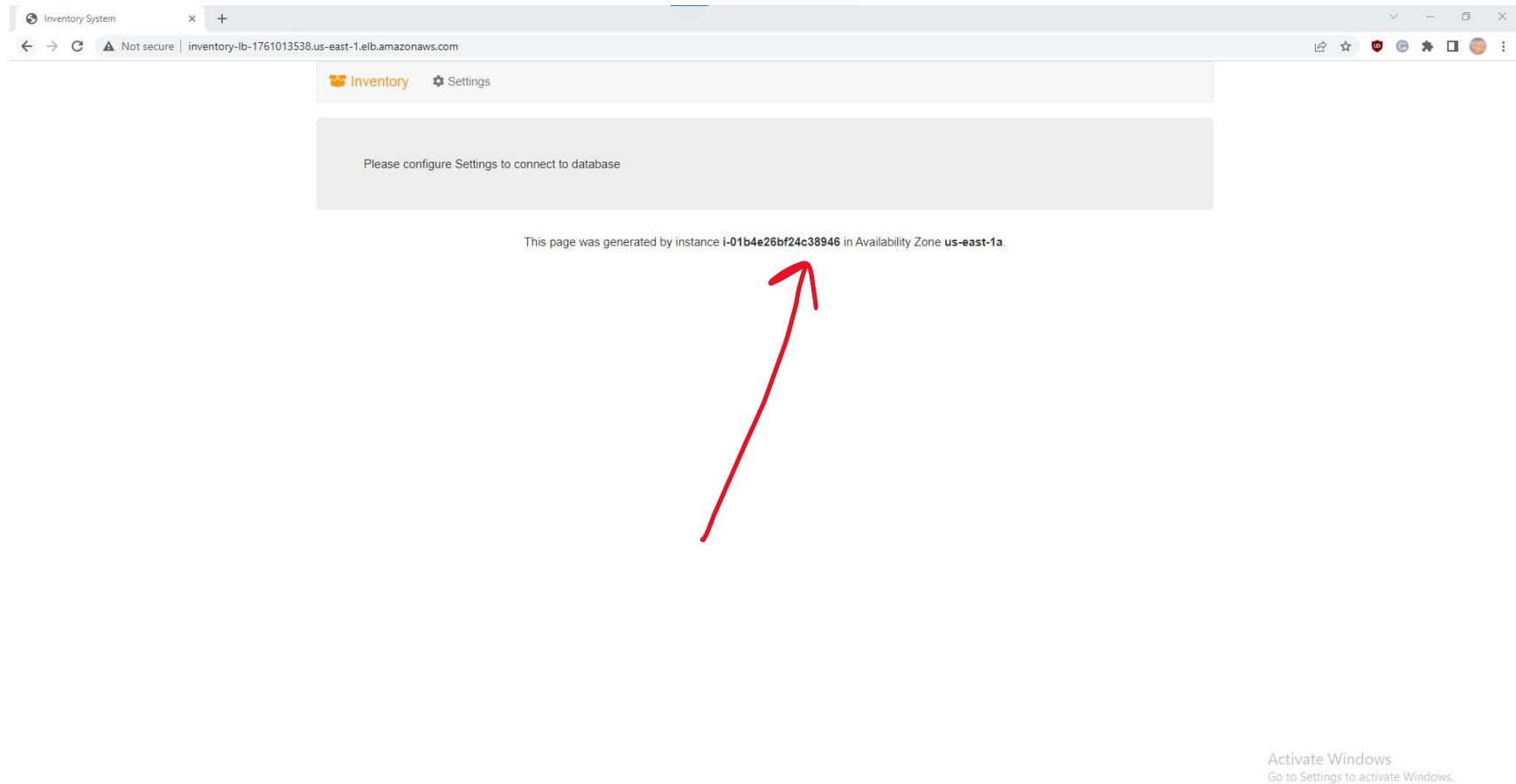
**Load balancer: Inventory-LB**

**Details**    [Listeners](#)    [Network mapping](#)    [Security](#)    [Monitoring](#)    [Integrations](#)    [Attributes](#)    [Tags](#)

**Details**

Load balancer type	Application	Status	Active	VPC	vpc-0d3aae45ce981f94f	IP address type	IPv4
Scheme	Internet-facing	Hosted zone	Z35SXDOTRQ7X7K	Availability Zones	subnet-08c56dec60e59ccb6, subnet-063edc828ecdaf7cd	Date created	July 2, 2023, 16:12 (UTC+07:00)
Load balancer ARN	arn:aws:elasticloadbalancing:us-east-1:202056316960:loadbalancer/app/Inventory-LB/3ecc3be9a013f23	DNS name	Inventory-LB-1761013538.us-east-1.elb.amazonaws.com (A Record)				

Steps 65-66: Copy the DNS name of the Inventory load balancer.



Steps 67-68: Pasting the DNS name into a new browser window results in a webpage hosted on one of the instances in the target group.

The screenshot shows the AWS EC2 Instances page. The left sidebar includes links for EC2 Dashboard, EC2 Global View, Events, Limits, Instances (selected), Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Scheduled Instances, Capacity Reservations, Images (AMIs, AMI Catalog), Elastic Block Store (Volumes, Snapshots, Lifecycle Manager), Network & Security (Security Groups, Elastic IPs, Placement Groups, Key Pairs), and CloudShell, Feedback, Language.

The main content area displays the 'Instances (3) Info' table:

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...	Elastic IP
Inventory-App	i-01b4e26bf24c38946	Terminated	t2.micro	-	No alarms	+ us-east-1a	-	-	-
Web Server 1	i-00501b164a0c4400a	Running	t2.micro	2/2 checks passed	No alarms	+ us-east-1a	ec2-54-85-183-129.co...	54.85.183.129	-
Inventory-App	i-0264a7cce63fa4977	Running	t2.micro	2/2 checks passed	No alarms	+ us-east-1b	-	-	-

A red arrow points to the 'Running' status of the second instance, 'Web Server 1'. A modal window titled 'Select an instance' is open below the table.

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Steps 69-73: Terminate one of the Inventory-App instances.

Screenshot of the AWS EC2 Instances page showing four instances. The instance with ID i-0264a7cc-53fa4977 is highlighted with a red arrow and has a tooltip 'Initializing'. The other three instances are healthy ('2/2 checks passed').

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...	Elastic IP
Inventory-App	i-01b4e26bf24c38946	Terminated	t2.micro	-	No alarms	+ us-east-1a	-	-	-
Web Server 1	i-00501b164a0c4400a	Running	t2.micro	2/2 checks passed	No alarms	+ us-east-1a	ec2-54-85-183-129.co...	54.85.183.129	-
Inventory-App	i-018bbc0dd42f976	Running	t2.micro	Initializing	No alarms	+ us-east-1a	-	-	-
Inventory-App	i-0264a7cc-53fa4977	Running	t2.micro	2/2 checks passed	No alarms	+ us-east-1b	-	-	-

Select an instance

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Steps 74-75: The auto-scaling group detects that only one instance is healthy, so it launches another.

# Optional task 1 - Making the database highly available

The screenshot shows the AWS RDS configuration interface. On the left, there's a sidebar with various options like Dashboard, Databases (which is selected), Query Editor, Performance insights, Snapshots, Exports in Amazon S3, Automated backups, Reserved instances, Proxies, Subnet groups, Parameter groups, Option groups, Custom engine versions, Zero-ETL Integrations, Events, Event subscriptions, Recommendations (4), and Certificate update.

The main area has three sections:

- Storage autoscaling**: Provides dynamic scaling support for your database's storage based on your application's needs. There's an info link and a checkbox for "Enable storage autoscaling".
- Availability & durability**:
  - Multi-AZ deployment**: Info link. It says "Create a standby instance (recommended for production usage)" (radio button selected) and "Do not create a standby instance".
- Connectivity**:
  - Network type**: Info link. It says "To use dual-stack mode, make sure that you associate an IPv6 CIDR block with a subnet in the VPC you specify." Two options are shown: "IPv4" (radio button selected) and "Dual-stack mode".
  - DB subnet group**: A dropdown menu showing "lab-db-subnet-group".
  - Security group**: A dropdown menu showing "Choose security groups".

At the bottom right, there's an "Activate Windows" link with the subtext "Go to Settings to activate Windows." The footer includes links for CloudShell, Feedback, Language, © 2023, Amazon Web Services, Inc. or its affiliates., Privacy, Terms, and Cookie preferences.

Steps 76-80: Modify the existing RDS instance to create a standby instance.

The screenshot shows the 'Instance configuration' page in the AWS RDS console. On the left, there's a sidebar with various navigation links like Dashboard, Databases, Query Editor, etc. The main area is titled 'Instance configuration' with the sub-instruction: 'The DB instance configuration options below are limited to those supported by the engine that you selected above.' Below this, the 'DB instance class' section is shown, with 'Burstable classes (includes t classes)' selected (indicated by a red arrow). Underneath, it lists 'db.t3.small' with details: '2 vCPUs', '2 GiB RAM', and 'Network: 2,085 Mbps'. There's also a checkbox for 'Include previous generation classes'. The next section is 'Storage', which includes 'General Purpose SSD (gp2)' selected as the storage type. A red arrow points to the 'Allocated storage' input field, which contains the value '10'. Below this, a note states: 'The minimum value is 20 GiB and the maximum value is 16,384 GiB'. The 'Storage autoscaling' section is present but has no checked options. At the bottom right, there are links for 'Activate Windows', 'CloudShell', 'Feedback', 'Language', and copyright information.

Steps 81-82: Change the instance class to db.t3.small and allocate 10 GiB of storage.

Screenshot of the Amazon RDS Modify DB instance: inventory-db page.

The left sidebar shows the Databases section selected. The main content area shows the following details:

Attribute	Current value	New value
DB instance class	db.t3.micro	db.t3.small
Multi-AZ deployment	No	Yes
Allocated storage	5 GiB	10 GiB

**Schedule modifications**

When to apply modifications:

- Apply during the next scheduled maintenance window  
Current maintenance window: Jun 04, 2023 12:29 - 12:59 UTC+7
- Apply immediately  
The modifications in this request and any pending modifications will be asynchronously applied as soon as possible, regardless of the maintenance window setting for this database instance.

**Potential performance impact when converting to Multi-AZ**

Your DB instance can experience a significant performance impact during and after converting to a Multi-AZ deployment. The impact is greater on DB instances with large amounts of storage and write-intensive workloads. We don't recommend this conversion on a production DB instance.

Buttons at the bottom: Cancel, Back, **Modify DB instance**.

Steps 83-85: Confirm the changes and select apply immediately.

## Optional task 2 - Configuring a highly available NAT gateway

The screenshot shows the 'Create NAT gateway' page in the AWS VPC service. The 'Subnet' dropdown is highlighted with a red arrow, indicating it is the current focus. The 'Connectivity type' is set to 'Public'. An 'Elastic IP allocation ID' is assigned. The 'Tags' section is empty.

**NAT gateway settings**

Name - *optional*  
Create a tag with a key of 'Name' and a value that you specify.  
my-nat-gateway-01  
The name can be up to 256 characters long.

Subnet  
Select a subnet in which to create the NAT gateway.  
subnet-063edc828ecdaf7cd (Public Subnet 2)

Connectivity type  
Select a connectivity type for the NAT gateway.  
 Public  
 Private

Elastic IP allocation ID [Info](#)  
Assign an Elastic IP address to the NAT gateway.  
eipalloc-02b097eb03ccc4d63 [Allocate Elastic IP](#)

► Additional settings [Info](#)

**Tags**  
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.  
No tags associated with the resource.  
[Add new tag](#)  
You can add 50 more tags.

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Steps 86-88: Create a new NAT gateway in Public Subnet 2.

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VPC > Route tables > Create route table

### Create route table Info

A route table specifies how packets are forwarded between the subnets within your VPC, the internet, and your VPN connection.

**Route table settings**

Name - *optional*  
Create a tag with a key of 'Name' and a value that you specify.

Private Route Table 2

VPC  
The VPC to use for this route table.

vpc-0d3aae45ce981f94f (Lab VPC) 

**Tags**  
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

Key Value - *optional*

Q Name X Q Private Route Table 2 X Remove

Add new tag

You can add 49 more tags.

Cancel **Create route table**

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Steps 89-90: Create a new route table in the Lab VPC.

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VPC > Route tables > rtb-0b85dc2fe20ffb9af > Edit routes

### Edit routes

Destination	Target	Status	Propagated
10.0.0.0/16	local	Active	No
0.0.0.0/0	nat-05ae7a685d9b00d0d	-	No

Add route ↑ Remove Cancel Preview Save changes

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Steps 91-92: Add a route entry that directs all Internet-bound traffic to the newly created NAT gateway.

You have successfully updated subnet associations for rtb-0b85dc2fe20ffb9af / Private Route Table 2.

VPC > Route tables > rtb-0b85dc2fe20ffb9af

## rtb-0b85dc2fe20ffb9af / Private Route Table 2

You can now check network connectivity with Reachability Analyzer

Run Reachability Analyzer

**Details** **Info**

Route table ID rtb-0b85dc2fe20ffb9af	Main No	Explicit subnet associations subnet-0fd3810c205320c6a / Private Subnet 2	Edge associations -
VPC vpc-0d3aae45ce981f94f   Lab VPC	Owner ID 202056316960		

Routes **Subnet associations** Edge associations Route propagation Tags

**Explicit subnet associations (1)**

Name	Subnet ID	IPv4 CIDR	IPv6 CIDR
Private Subnet 2	subnet-0fd3810c205320c6a	10.0.4.0/23	-

**Edit subnet associations**

**Subnets without explicit associations (0)**

The following subnets have not been explicitly associated with any route tables and are therefore associated with the main route table:

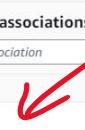
Name	Subnet ID	IPv4 CIDR	IPv6 CIDR
No subnets without explicit associations			
All your subnets are associated with a route table.			

**Edit subnet associations**

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Steps 93-96: Associate Private Subnet 2 with the new route table.