Name:Shubham Jha D15C Roll. No 19

Aim:

To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.

Theory:

Container-based microservices architectures have revolutionized how development and operations teams test and deploy modern software. Containers allow companies to scale and deploy applications more efficiently, but they also introduce new challenges, adding complexity by creating a whole new infrastructure ecosystem.

Today, both large and small software companies are deploying thousands of container instances daily. Managing this level of complexity at scale requires advanced tools. Like Kubernetes.

Originally developed by Google, Kubernetes is an open-source container orchestration platform designed to automate the deployment, scaling, and management of containerized applications. Kubernetes has quickly become the de facto standard for container orchestration and is the flagship project of the Cloud Native Computing Foundation (CNCF), supported by major players like Google, AWS, Microsoft, IBM, Intel, Cisco, and Red Hat.

Kubernetes simplifies the deployment and operation of applications in a microservice architecture by providing an abstraction layer over a group of hosts. This allows development teams to deploy their applications while Kubernetes takes care of key tasks, including:

- Managing resource consumption by applications or teams
- Distributing application load evenly across the infrastructure
- Automatically load balancing requests across multiple instances of an application
- Monitoring resource usage to prevent applications from exceeding resource limits and automatically restarting them if needed

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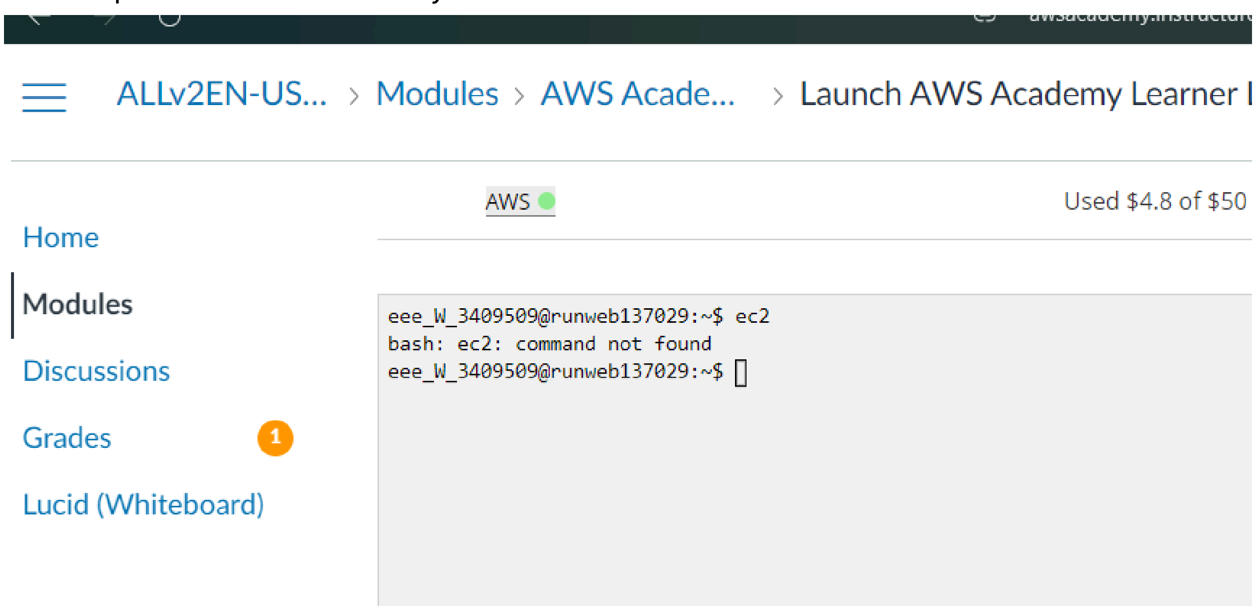
- Moving application instances between hosts when resources are low or if a host fails
- Automatically utilizing additional resources when new hosts are added to the cluster
- Facilitating canary deployments and rollbacks with ease.

Steps:

Set Up the instances of each machine

1. open the aws academy.


ALLv2EN-US... › Modules › AWS Acade... › Launch AWS Academy Learner l
AWS
Used $4.8 of $50
Home
Modules
Discussions
Grades
1
Lucid (Whiteboard)

```
eee_W_3409509@runweb137029:~$ ec2
bash: ec2: command not found
eee_W_3409509@runweb137029:~$ 
```

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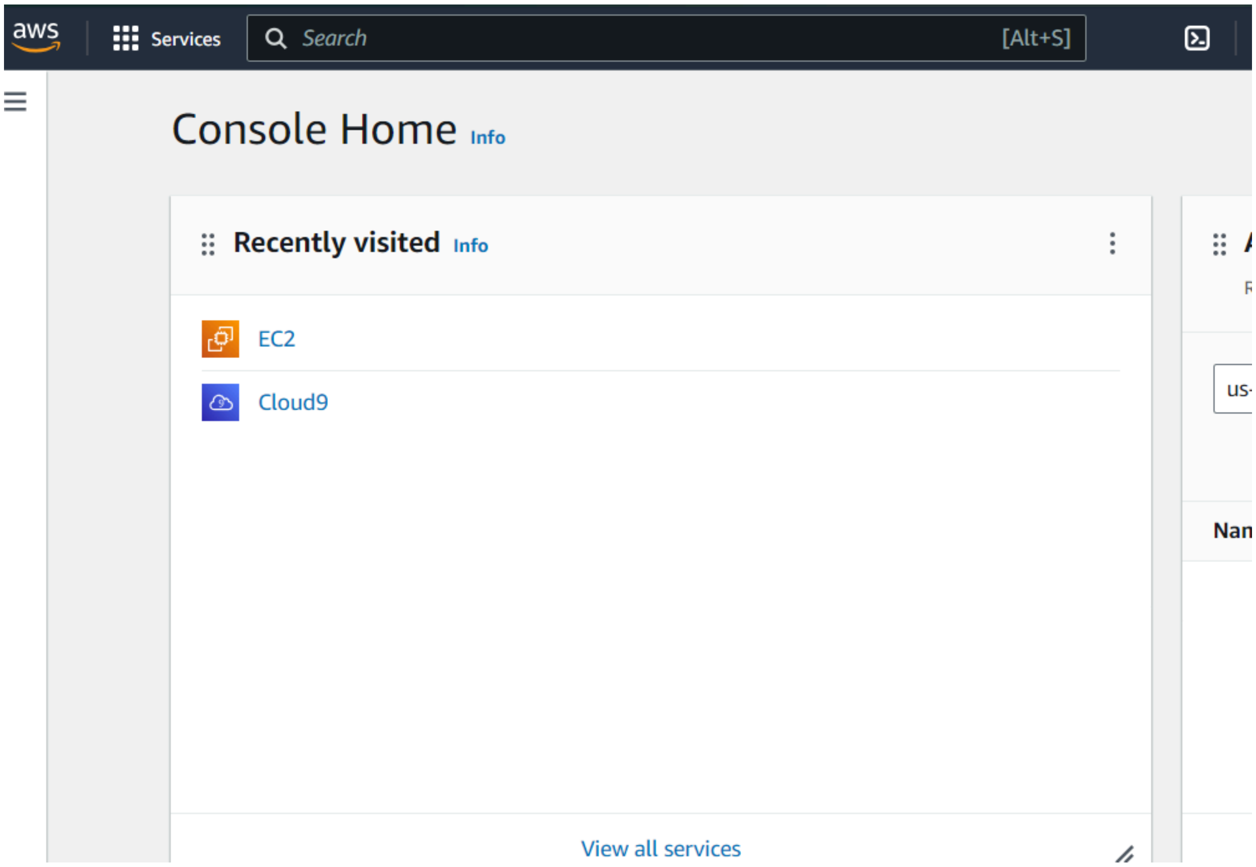


Console Home Info

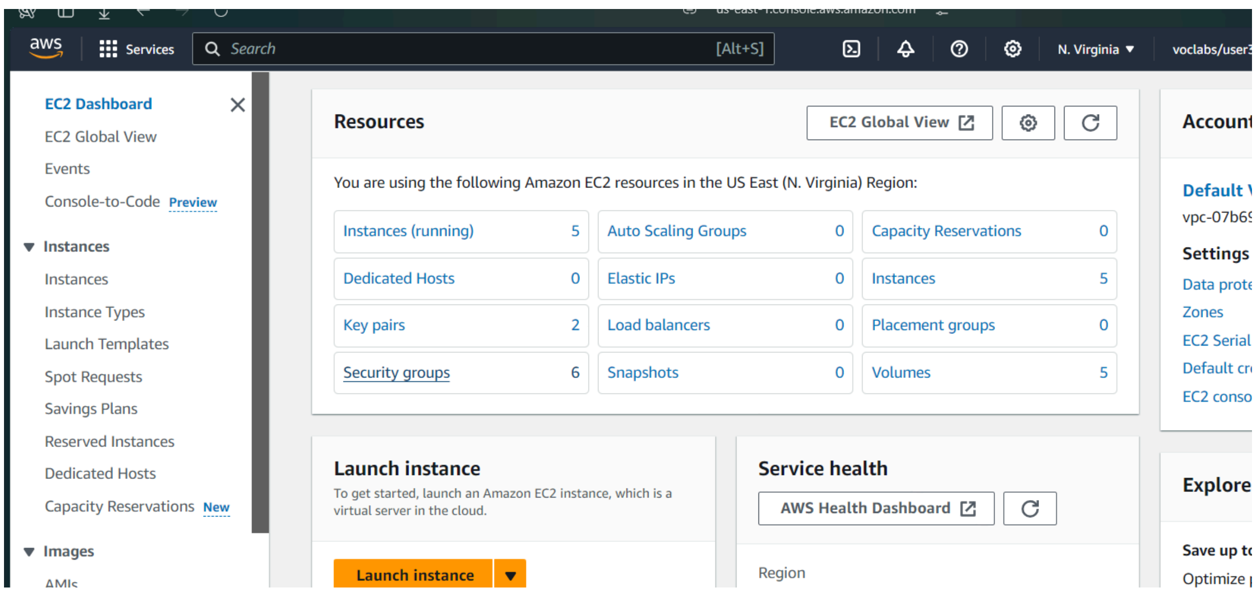
Recently visited Info

EC2

Cloud9

View all services

2. Click on security groups



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 New
Images
AMIs

Resources

You are using the following Amazon EC2 resources in the US East (N. Virginia) Region:

Instances (running)	5	Auto Scaling Groups	0	Capacity Reservations	0
Dedicated Hosts	0	Elastic IPs	0	Instances	5
Key pairs	2	Load balancers	0	Placement groups	0
Security groups	6	Snapshots	0	Volumes	5

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Launch instance

Service health

AWS Health Dashboard

Region

3. create two secure groups one for master and other for the two nodes.

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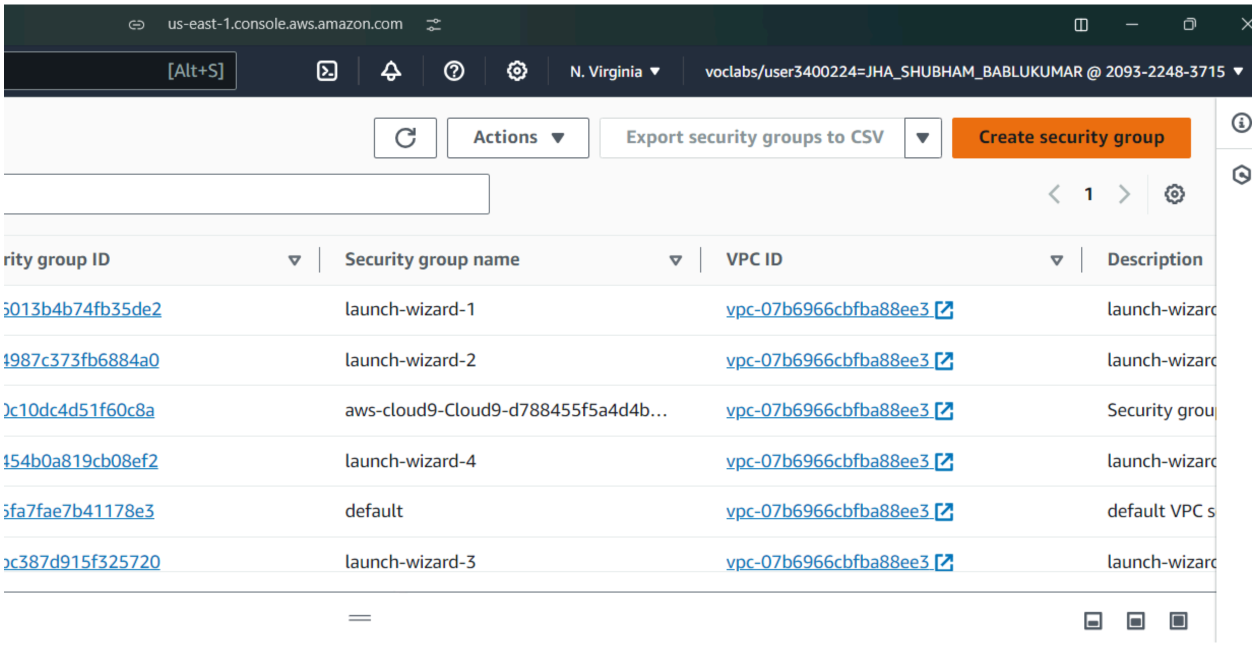
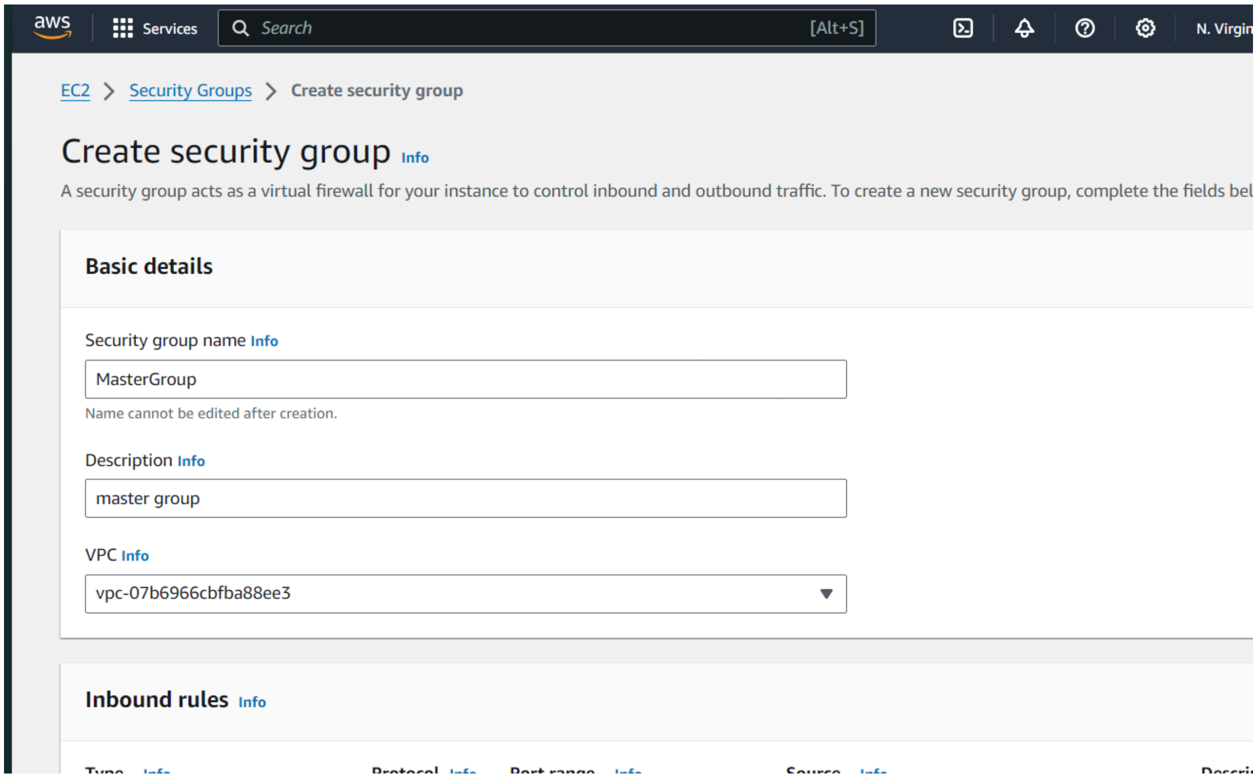


us-east-1.console.aws.amazon.com

N. Virginia voclabs/user3400224=JHA_SHUBHAM_BABLUKUMAR @ 2093-2248-3715

rity group ID	Security group name	VPC ID	Description
5013b4b74fb35de2	launch-wizard-1	vpc-07b6966cbfba88ee3	launch-wizard
4987c373fb6884a0	launch-wizard-2	vpc-07b6966cbfba88ee3	launch-wizard
0c10dc4d51f60c8a	aws-cloud9-Cloud9-d788455f5a4d4b…	vpc-07b6966cbfba88ee3	Security grou
454b0a819cb08ef2	launch-wizard-4	vpc-07b6966cbfba88ee3	launch-wizard
5fa7fae7b41178e3	default	vpc-07b6966cbfba88ee3	default VPC s
0c387d915f325720	launch-wizard-3	vpc-07b6966cbfba88ee3	launch-wizard

4. enter details and add inbound rules (I have given MasterGroup for the master group)



EC2 > Security Groups > Create security group

Create security group Info

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. To create a new security group, complete the fields bel

Basic details

Security group name Info: MasterGroup

Name cannot be edited after creation.

Description Info: master group

VPC Info: vpc-07b6966cbfba88ee3

Inbound rules Info

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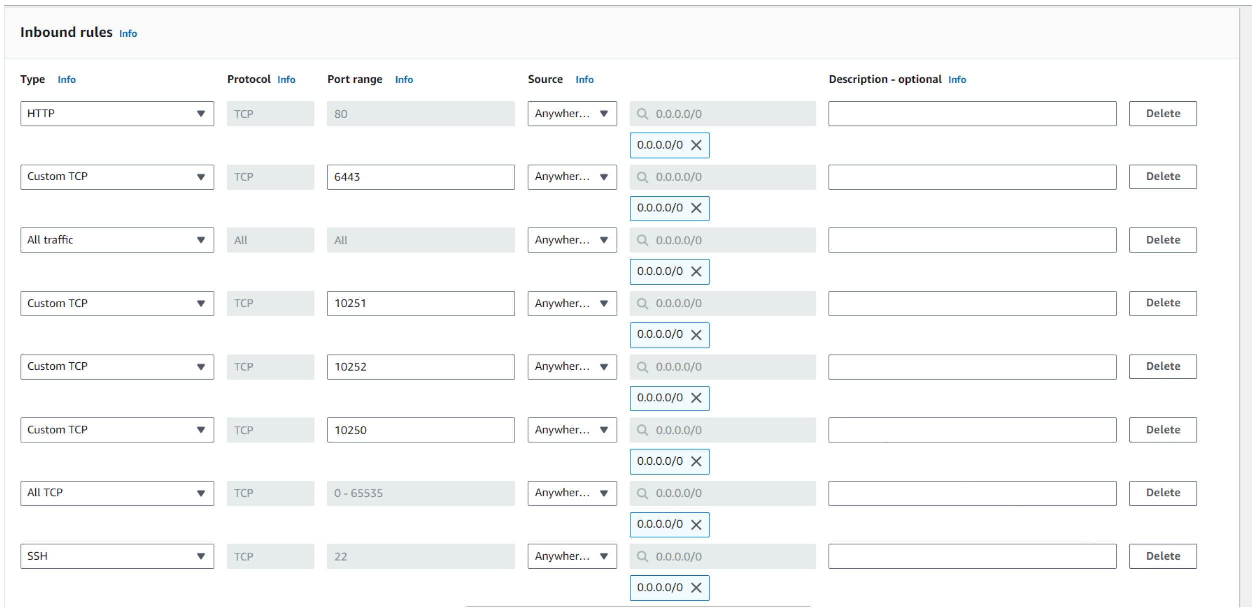
You have to look for the particular configuration which I did (in the image below)

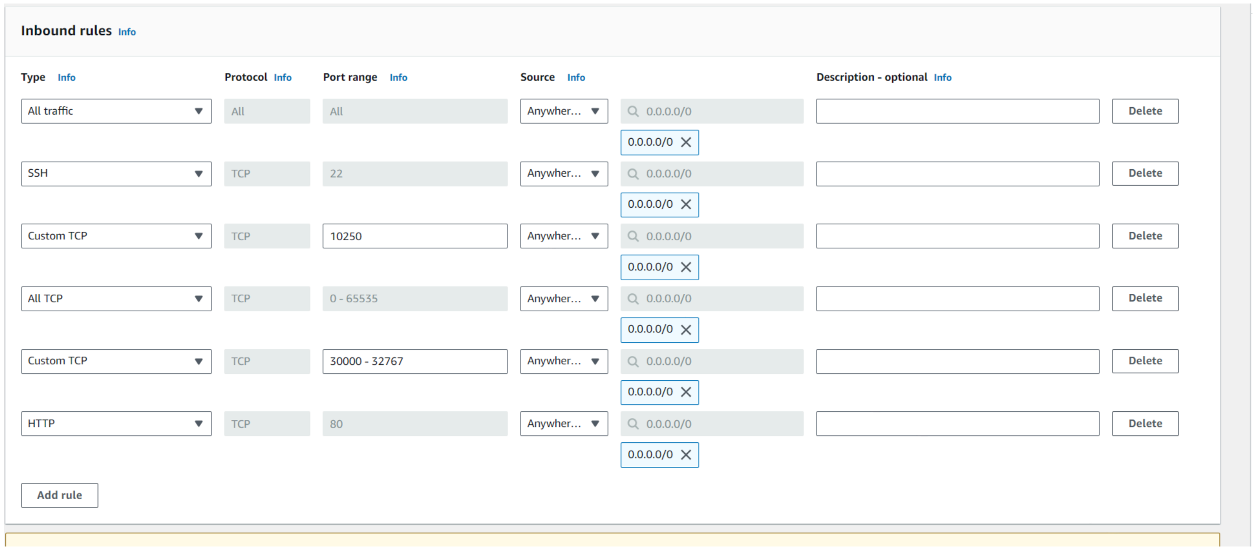


Inbound rules

Type	Protocol	Port range	Source		Description - optional
HTTP	TCP	80	Anywher...	0.0.0.0/0	
Custom TCP	TCP	6443	Anywher...	0.0.0.0/0	
All traffic	All	All	Anywher...	0.0.0.0/0	
Custom TCP	TCP	10251	Anywher...	0.0.0.0/0	
Custom TCP	TCP	10252	Anywher...	0.0.0.0/0	
Custom TCP	TCP	10250	Anywher...	0.0.0.0/0	
All TCP	TCP	0 - 65535	Anywher...	0.0.0.0/0	
SSH	TCP	22	Anywher...	0.0.0.0/0	

click on create security group below.

now do the same for a node group.



Inbound rules

Type	Protocol	Port range	Source		Description - optional
All traffic	All	All	Anywher...	0.0.0.0/0	
SSH	TCP	22	Anywher...	0.0.0.0/0	
Custom TCP	TCP	10250	Anywher...	0.0.0.0/0	
All TCP	TCP	0 - 65535	Anywher...	0.0.0.0/0	
Custom TCP	TCP	30000 - 32767	Anywher...	0.0.0.0/0	
HTTP	TCP	80	Anywher...	0.0.0.0/0	

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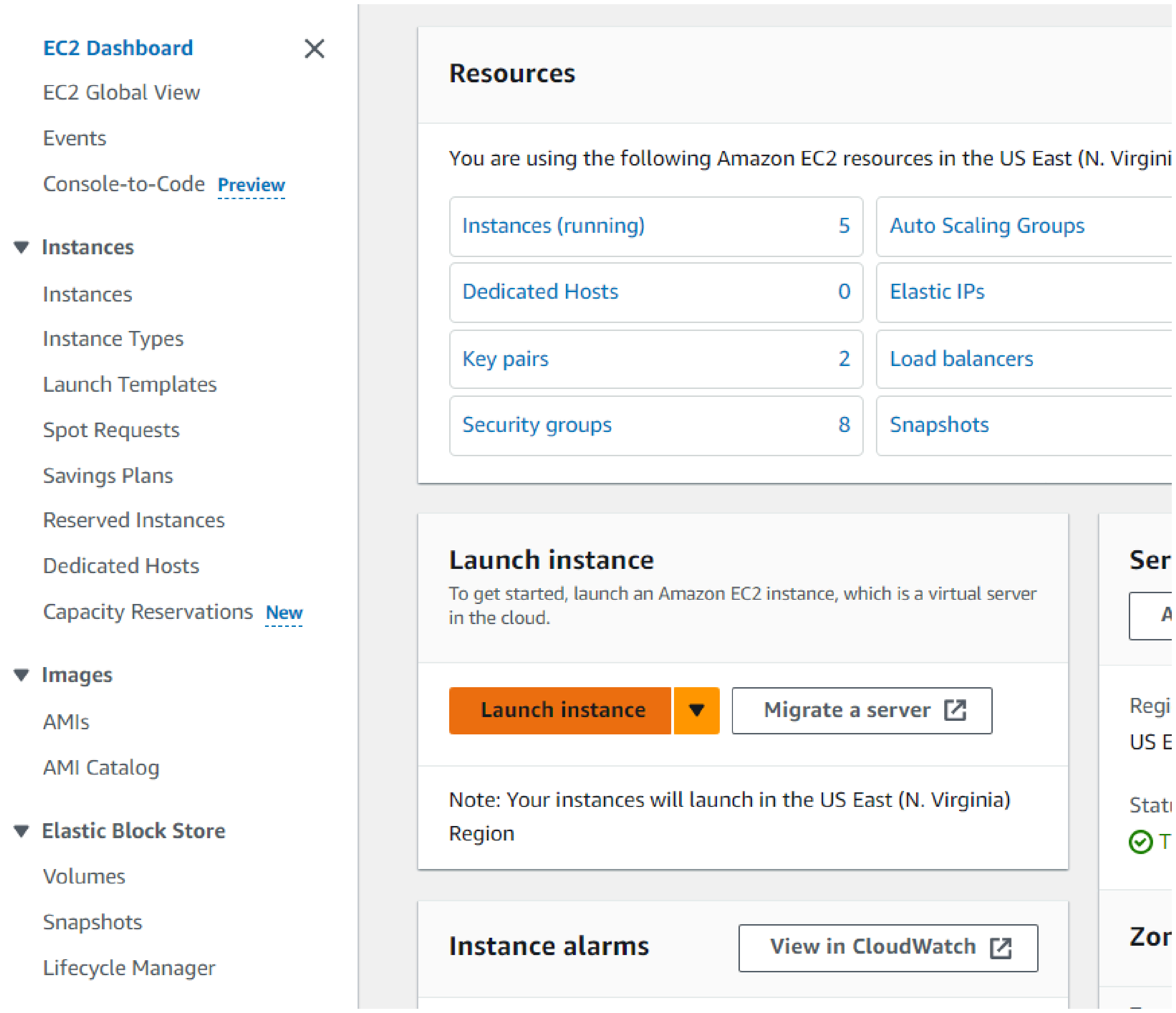
5. now go to ec2 and launch an instance



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 New

Images
- AMIs
- AMI Catalog

Elastic Block Store
- Volumes
- Snapshots
- Lifecycle Manager

Resources

You are using the following Amazon EC2 resources in the US East (N. Virgini

Instances (running)	5	Auto Scaling Groups
Dedicated Hosts	0	Elastic IPs
Key pairs	2	Load balancers
Security groups	8	Snapshots

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Note: Your instances will launch in the US East (N. Virginia) Region

Instance alarms

add name and set ubuntu:

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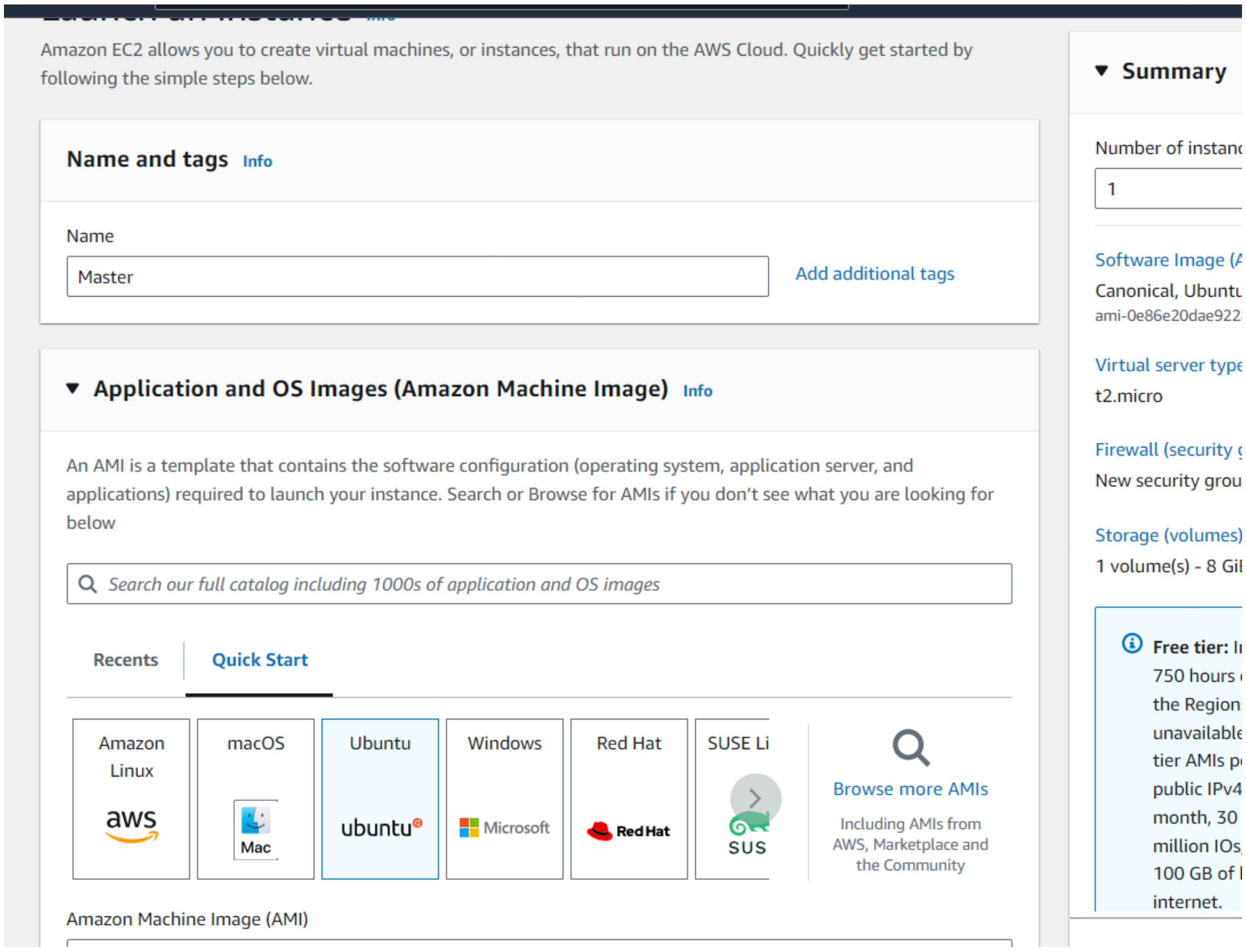


Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

Name and tags Info

Name: Master

Add additional tags

Application and OS Images (Amazon Machine Image) Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Recents | Quick Start

Amazon Linux | macOS | Ubuntu | Windows | Red Hat | SUSE Li

Browse more AMIs

Including AMIs from AWS, Marketplace and the Community

Amazon Machine Image (AMI)

Summary

Number of instanc
1

Software Image (A
Canonical, Ubuntu
ami-0e86e20dae922

Virtual server type
t2.micro

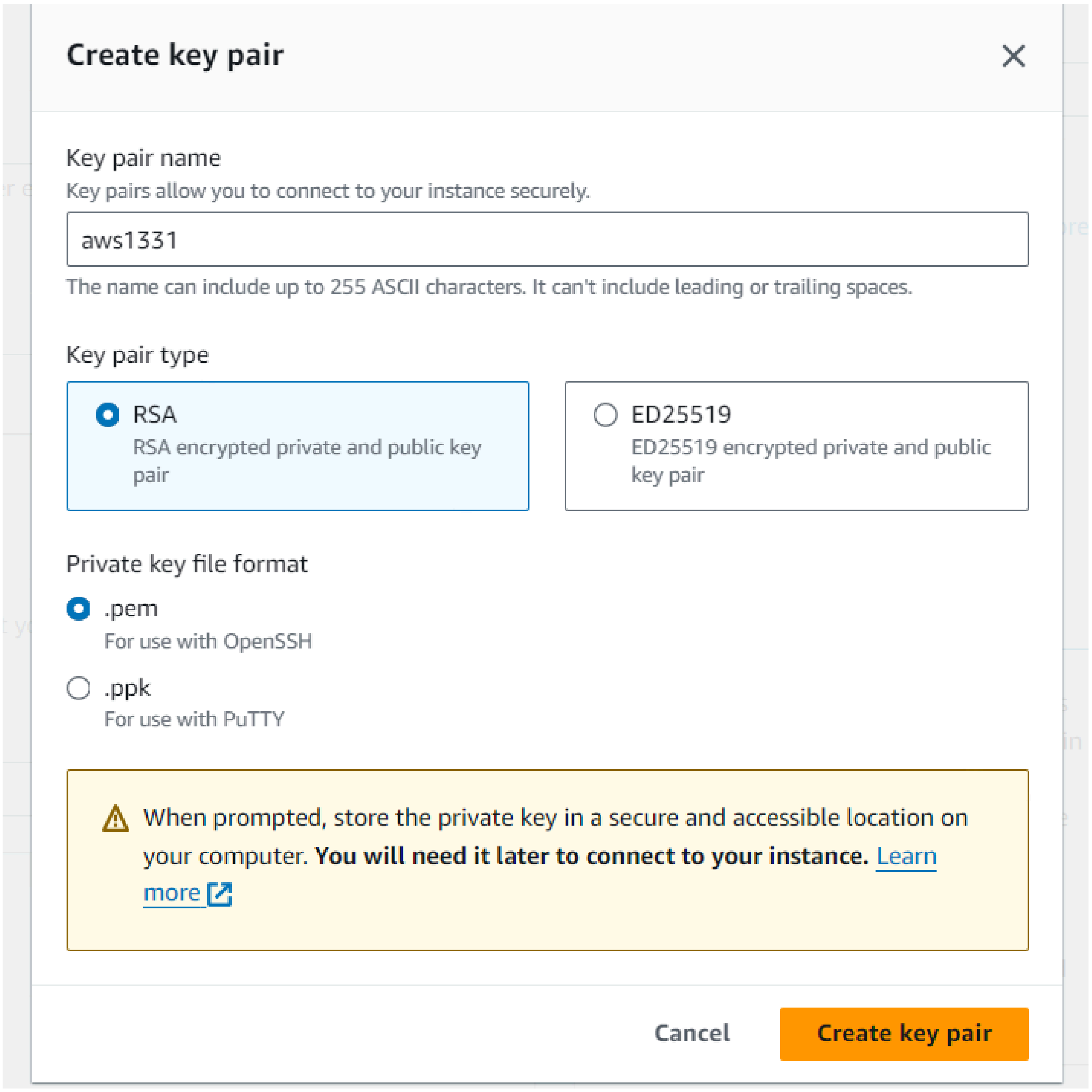
Firewall (security g
New security grou

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

Free tier: I
750 hours
the Region
unavailable
tier AMIs p
public IPv4
month, 30
million IOs
100 GB of
internet.

```
create a key if you want
```

Name:Shubham Jha D15C Roll. No 19


Create key pair

Key pair name

Key pairs allow you to connect to your instance securely.

aws1331

The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.

Key pair type

● RSA
RSA encrypted private and public key pair

○ ED25519
ED25519 encrypted private and public key pair

Private key file format

● .pem
For use with OpenSSH

○ .ppk
For use with PuTTY

When prompted, store the private key in a secure and accessible location on your computer. **You will need it later to connect to your instance.** Learn more

If you want you can reuse the key pair generated earlier.

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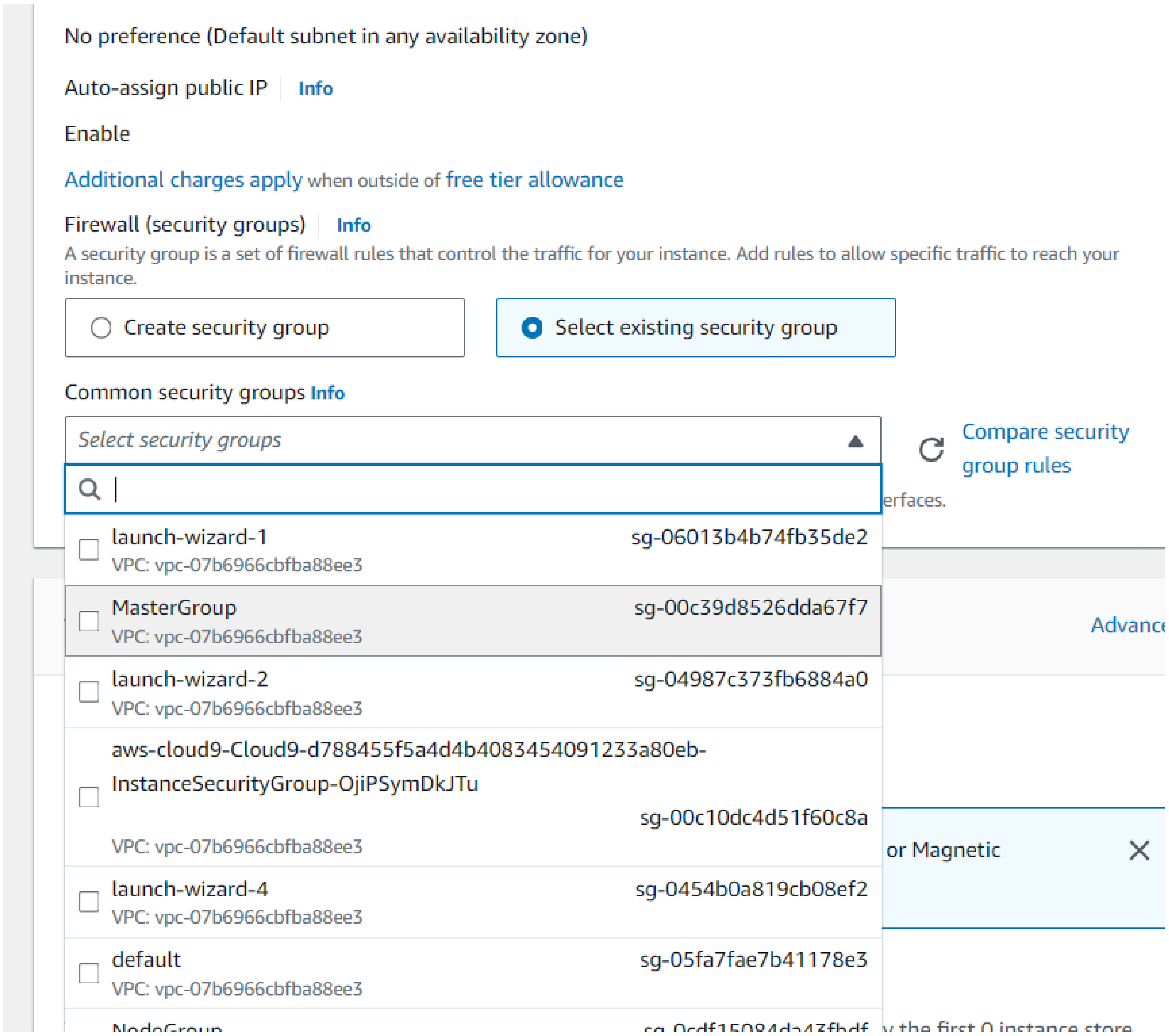
Select the security group for master.



No preference (Default subnet in any availability zone)

Auto-assign public IP | Info

Enable

Additional charges apply when outside of free tier allowance

Firewall (security groups) | Info

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

Create security group [✓ Select existing security group]

Common security groups Info

Select security groups

Compare security group rules

erfaces.

launch-wizard-1 VPC: vpc-07b6966cbfba88ee3	sg-06013b4b74fb35de2
MasterGroup VPC: vpc-07b6966cbfba88ee3	sg-00c39d8526dda67f7
launch-wizard-2 VPC: vpc-07b6966cbfba88ee3	sg-04987c373fb6884a0
aws-cloud9-Cloud9-d788455f5a4d4b4083454091233a80eb-InstanceSecurityGroup-OjiPSymDkJTu VPC: vpc-07b6966cbfba88ee3	sg-00c10dc4d51f60c8a
launch-wizard-4 VPC: vpc-07b6966cbfba88ee3	sg-0454b0a819cb08ef2
default VPC: vpc-07b6966cbfba88ee3	sg-05fa7fae7b41178e3

Advance

or Magnetic

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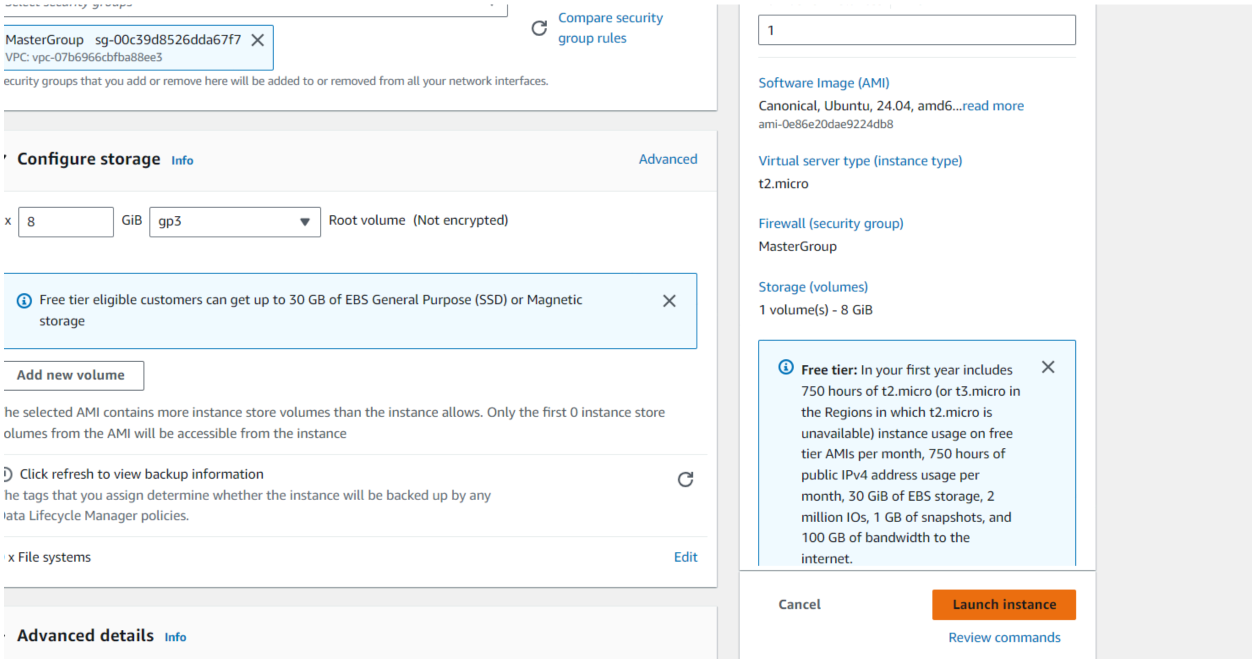
then launch:



MasterGroup sg-00c39d8526dda67f7
VPC: vpc-07b6966cbfba88ee3
ecurity groups that you add or remove here will be added to or removed from all your network interfaces.

Configure storage Info

x 8 GiB gp3 Root volume (Not encrypted)

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage

Add new volume

he selected AMI contains more instance store volumes than the instance allows. Only the first 0 instance store olumes from the AMI will be accessible from the instance

Click refresh to view backup information
he tags that you assign determine whether the instance will be backed up by any ata Lifecycle Manager policies.

x File systems Edit

Advanced details Info

1

Software Image (AMI)
Canonical, Ubuntu, 24.04, amd6...read more
ami-0e86e20dae9224db8

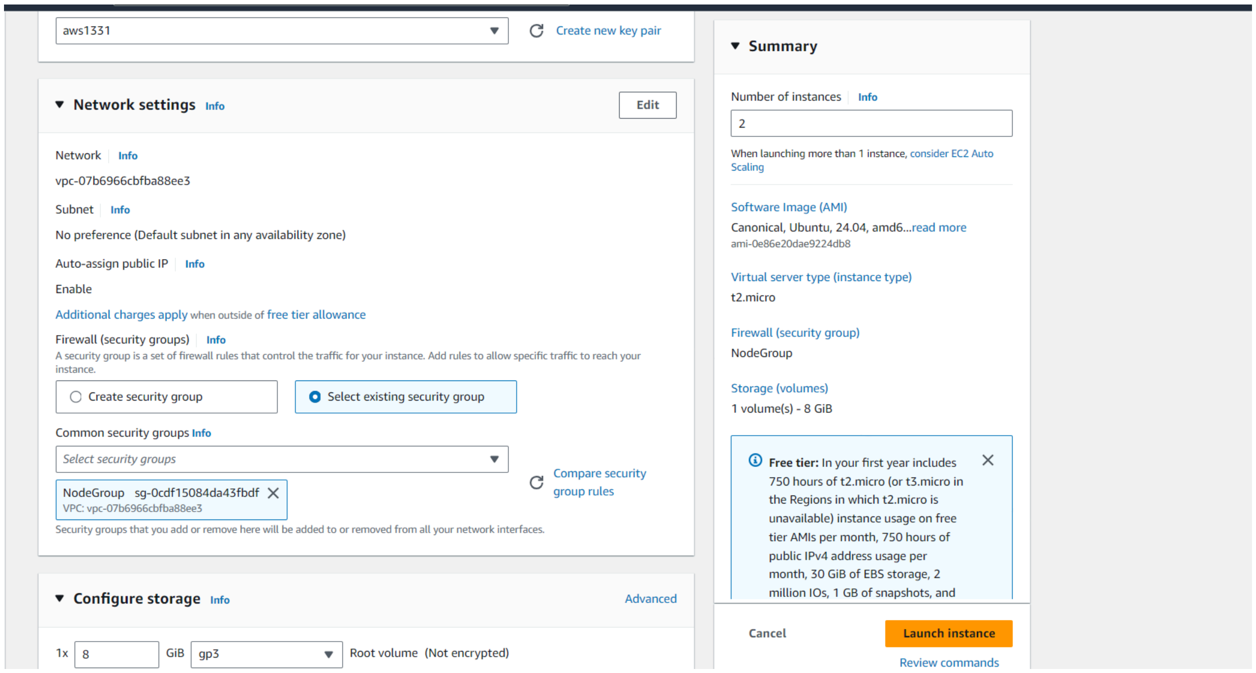
Virtual server type (instance type)
t2.micro

Firewall (security group)
MasterGroup

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, 750 hours of public IPv4 address usage per month, 30 GiB of EBS storage, 2 million IOs, 1 GB of snapshots, and 100 GB of bandwidth to the internet.

do the same for node instance just select the number of instance as 2. and select custom security group as node group.



aws1331

Network settings Info

Network Info
vpc-07b6966cbfba88ee3

Subnet Info
No preference (Default subnet in any availability zone)

Auto-assign public IP Info
Enable

Additional charges apply when outside of free tier allowance

Firewall (security groups) Info
A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

Create security group [✓ Select existing security group]

Common security groups Info
Select security groups
NodeGroup sg-0cdf15084da43fbdf
VPC: vpc-07b6966cbfba88ee3
Security groups that you add or remove here will be added to or removed from all your network interfaces.

Configure storage Info

1x 8 GiB gp3 Root volume (Not encrypted)

Summary

Number of instances Info
2
When launching more than 1 instance, consider EC2 Auto Scaling

Software Image (AMI)
Canonical, Ubuntu, 24.04, amd6...read more
ami-0e86e20dae9224db8

Virtual server type (instance type)
t2.micro

Firewall (security group)
NodeGroup

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, 750 hours of public IPv4 address usage per month, 30 GiB of EBS storage, 2 million IOs, 1 GB of snapshots, and

dont give name now. and launch instance.

now go to instances and give name to the blanck ones:

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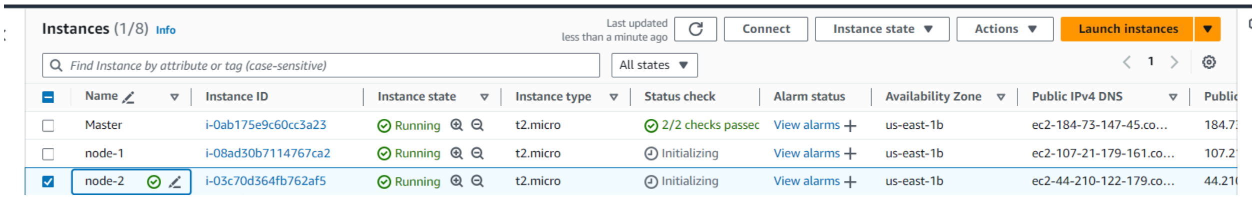
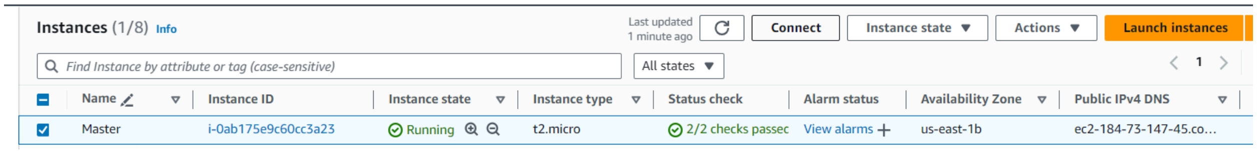


Instances (1/8) Info

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 DNS	Public
☐	Master	i-0ab175e9c60cc3a23	Running	t2.micro	2/2 checks passec	View alarms	us-east-1b	ec2-184-73-147-45.co...	184.7
☐	node-1	i-08ad30b7114767ca2	Running	t2.micro	Initializing	View alarms	us-east-1b	ec2-107-21-179-161.co...	107.2
☑	node-2	i-03c70d364fb762af5	Running	t2.micro	Initializing	View alarms	us-east-1b	ec2-44-210-122-179.co...	44.21

6. select master and connect:

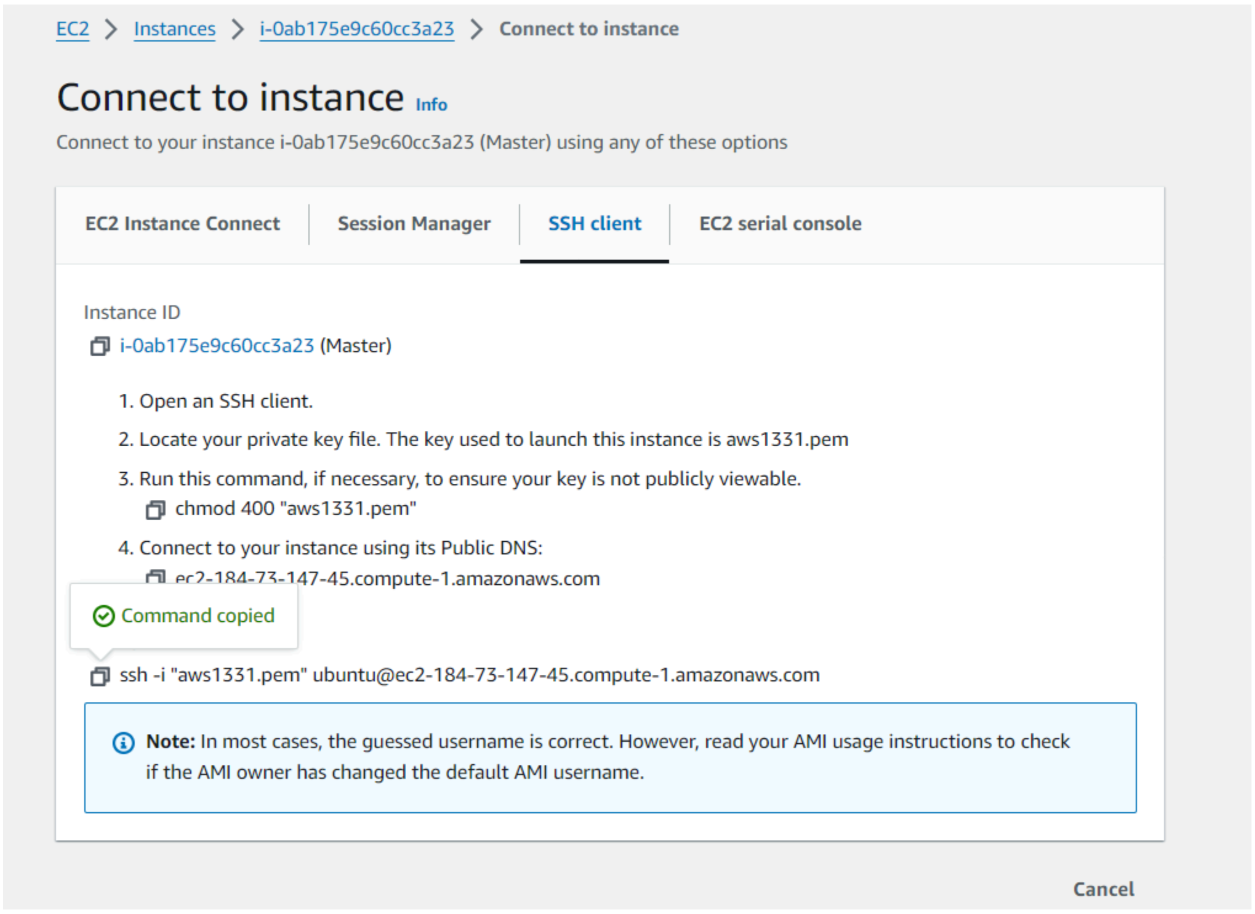


Instances (1/8) Info

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 DNS
☑	Master	i-0ab175e9c60cc3a23	Running	t2.micro	2/2 checks passec	View alarms	us-east-1b	ec2-184-73-147-45.co...

click on ssh client:
copy the command below the SSH client session



EC2 > Instances > i-0ab175e9c60cc3a23 > Connect to instance

Connect to instance Info

Connect to your instance i-0ab175e9c60cc3a23 (Master) using any of these options

EC2 Instance Connect | Session Manager | SSH client | EC2 serial console

Instance ID

i-0ab175e9c60cc3a23 (Master)

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is aws1331.pem
3. Run this command, if necessary, to ensure your key is not publicly viewable.
```
chmod 400 "aws1331.pem"
```
4. Connect to your instance using its Public DNS:
```
ec2-184-73-147-45.compute-1.amazonaws.com
```

Command copied

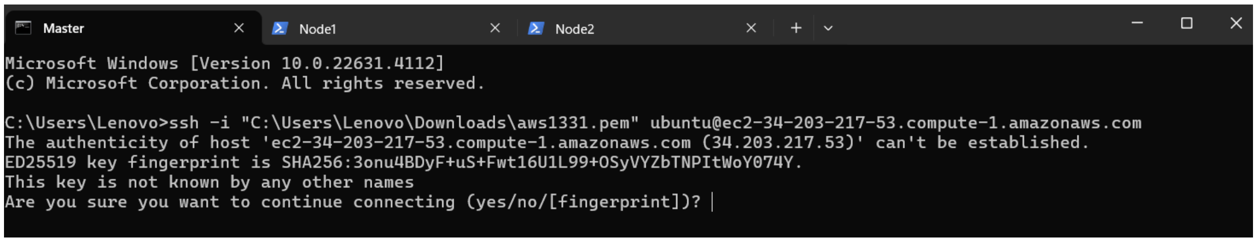
```
ssh -i "aws1331.pem" ubuntu@ec2-184-73-147-45.compute-1.amazonaws.com
```

Note: In most cases, the guessed username is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI username.

Cancel

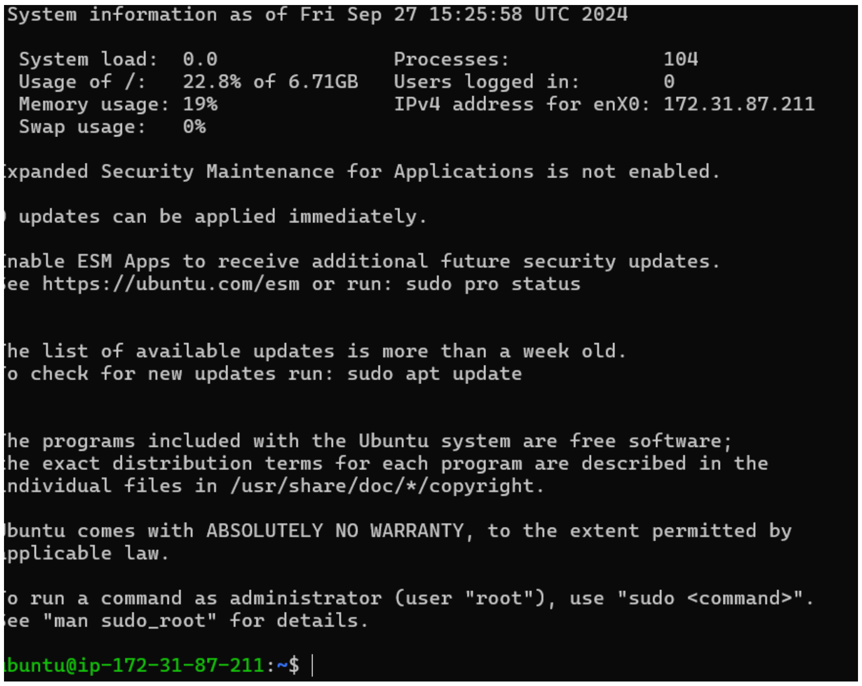
Name:Shubham Jha D15C Roll. No 19

7. Enter the copied command to a terminal window.



```
Microsoft Windows [Version 10.0.22631.4112]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Lenovo>ssh -i "C:\Users\Lenovo\Downloads\aws1331.pem" ubuntu@ec2-34-203-217-53.compute-1.amazonaws.com
The authenticity of host 'ec2-34-203-217-53.compute-1.amazonaws.com (34.203.217.53)' can't be established.
ED25519 key fingerprint is SHA256:3onu4BDyF+uS+Fwt16U1L99+0SyVYZbTNPItWoY074Y.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])?
```

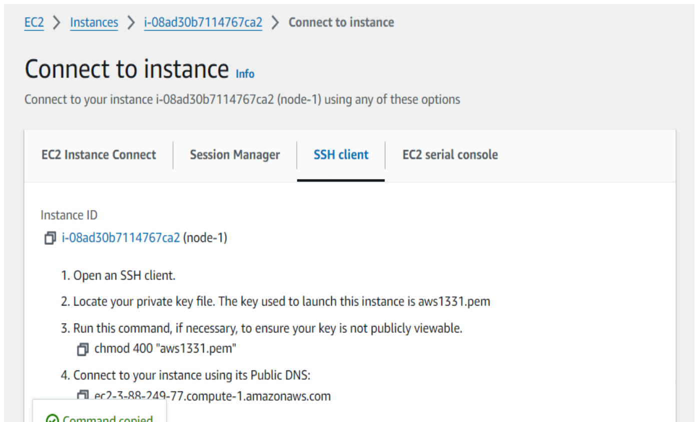
It would prompt whether we want to continue connecting. type yes.



```
System information as of Fri Sep 27 15:25:58 UTC 2024

 System load:  0.0               Processes:             104
 Usage of /:   22.8% of 6.71GB   Users logged in:       0
 Memory usage: 19%               IPv4 address for enX0: 172.31.87.211
 Swap usage:   0%

xpanded Security Maintenance for Applications is not enabled.

 updates can be applied immediately.

nable ESM Apps to receive additional future security updates.
ee https://ubuntu.com/esm or run: sudo pro status


he list of available updates is more than a week old.
o check for new updates run: sudo apt update


he programs included with the Ubuntu system are free software;
he exact distribution terms for each program are described in the
ndividual files in /usr/share/doc/*/copyright.

buntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
pplicable law.

o run a command as administrator (user "root"), use "sudo <command>".
ee "man sudo_root" for details.

buntu@ip-172-31-87-211:~$
```

The step is similar for node 1 and node 2 instances too. Just use different terminal windows.

node 1:



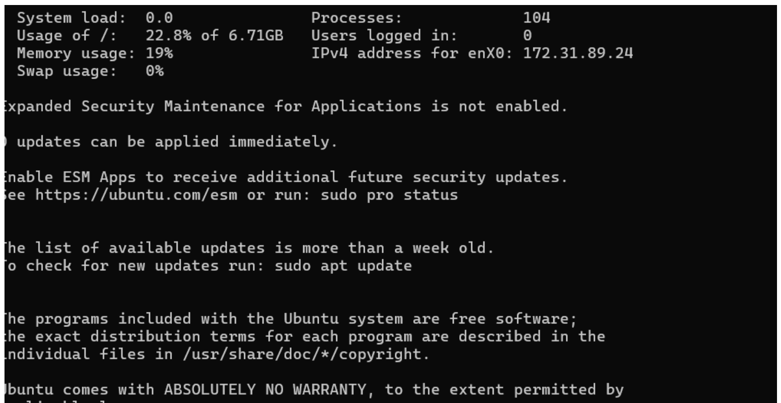
Connect to instance

Connect to your instance i-08ad30b7114767ca2 (node-1) using any of these options

Instance ID

i-08ad30b7114767ca2 (node-1)

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is aws1331.pem
3. Run this command, if necessary, to ensure your key is not publicly viewable.
   chmod 400 "aws1331.pem"
4. Connect to your instance using its Public DNS:
   ec2-3-88-249-77.compute-1.amazonaws.com



```
 System load:  0.0               Processes:             104
 Usage of /:   22.8% of 6.71GB   Users logged in:       0
 Memory usage: 19%               IPv4 address for enX0: 172.31.89.24
 Swap usage:   0%

xpanded Security Maintenance for Applications is not enabled.

 updates can be applied immediately.

nable ESM Apps to receive additional future security updates.
ee https://ubuntu.com/esm or run: sudo pro status


he list of available updates is more than a week old.
o check for new updates run: sudo apt update


he programs included with the Ubuntu system are free software;
he exact distribution terms for each program are described in the
ndividual files in /usr/share/doc/*/copyright.

buntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
```

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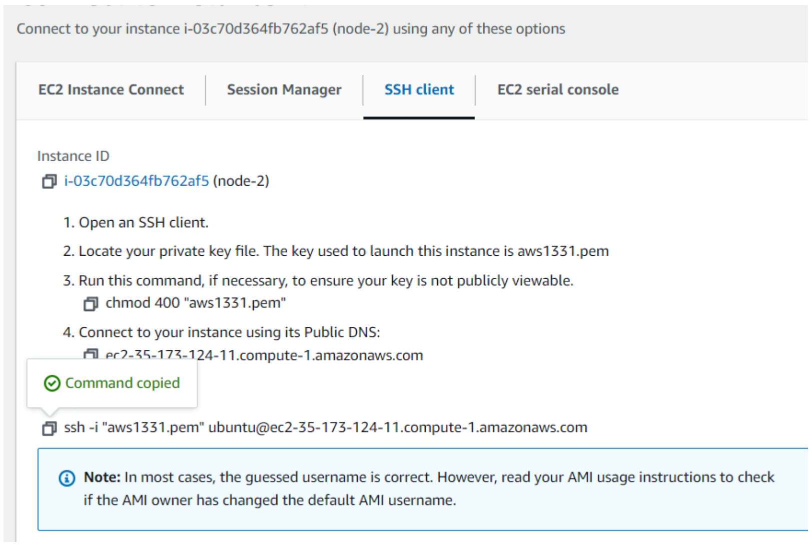
node 2 :



Connect to your instance i-03c70d364fb762af5 (node-2) using any of these options

Instance ID

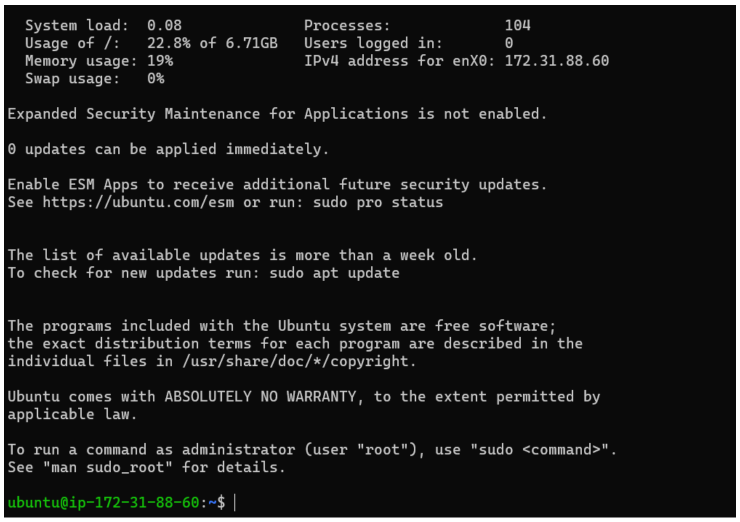
i-03c70d364fb762af5 (node-2)

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is aws1331.pem
3. Run this command, if necessary, to ensure your key is not publicly viewable.
   chmod 400 "aws1331.pem"
4. Connect to your instance using its Public DNS:
   ec2-35-173-124-11.compute-1.amazonaws.com

Command copied

ssh -i "aws1331.pem" ubuntu@ec2-35-173-124-11.compute-1.amazonaws.com

Note: In most cases, the guessed username is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI username.



```
  System load:  0.08              Processes:             104
  Usage of /:   22.8% of 6.71GB   Users logged in:       0
  Memory usage: 19%               IPv4 address for enX0: 172.31.88.60
  Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


The list of available updates is more than a week old.
To check for new updates run: sudo apt update


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-88-60:~$
```

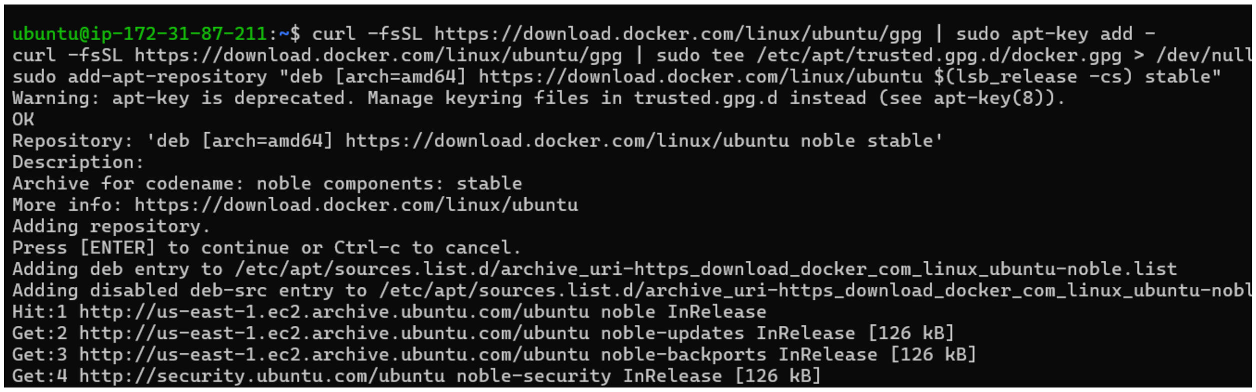
8. From now on run the commands on all the 3 terminals unless instructed otherwise.

and the images (screen shots) will only be of master unless stated otherwise.

curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -

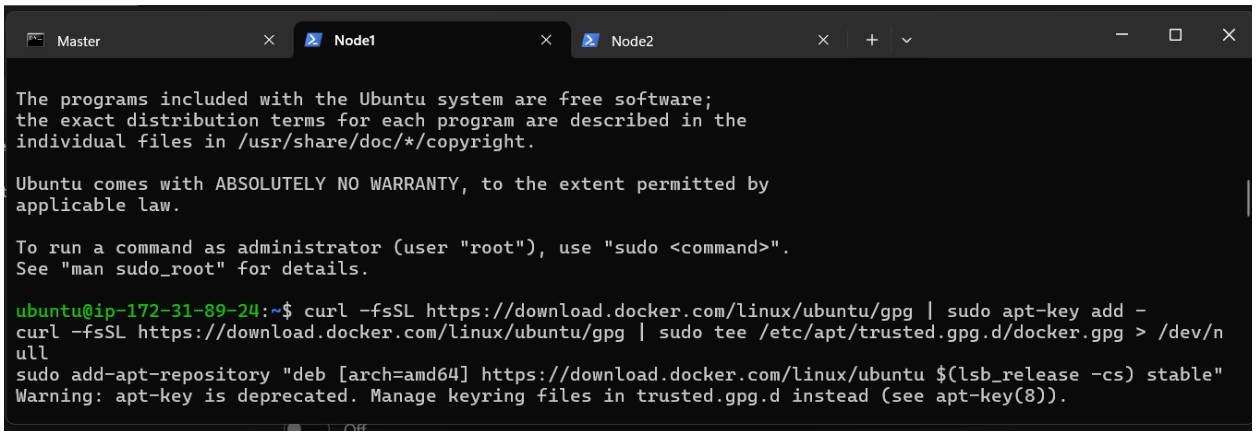
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo tee /etc/apt/trusted.gpg.d/docker.gpg > /dev/null

sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"



```
ubuntu@ip-172-31-87-211:~$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo tee /etc/apt/trusted.gpg.d/docker.gpg > /dev/null
sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"
Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
OK
Repository: 'deb [arch=amd64] https://download.docker.com/linux/ubuntu noble stable'
Description:
Archive for codename: noble components: stable
More info: https://download.docker.com/linux/ubuntu
Adding repository.
Press [ENTER] to continue or Ctrl-c to cancel.
Adding deb entry to /etc/apt/sources.list.d/archive_uri-https_download_docker_com_linux_ubuntu-noble.list
Adding disabled deb-src entry to /etc/apt/sources.list.d/archive_uri-https_download_docker_com_linux_ubuntu-nobl
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:4 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
```

now for node1 and node2:



```
The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-89-24:~$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo tee /etc/apt/trusted.gpg.d/docker.gpg > /dev/n
ull
sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"
Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
```

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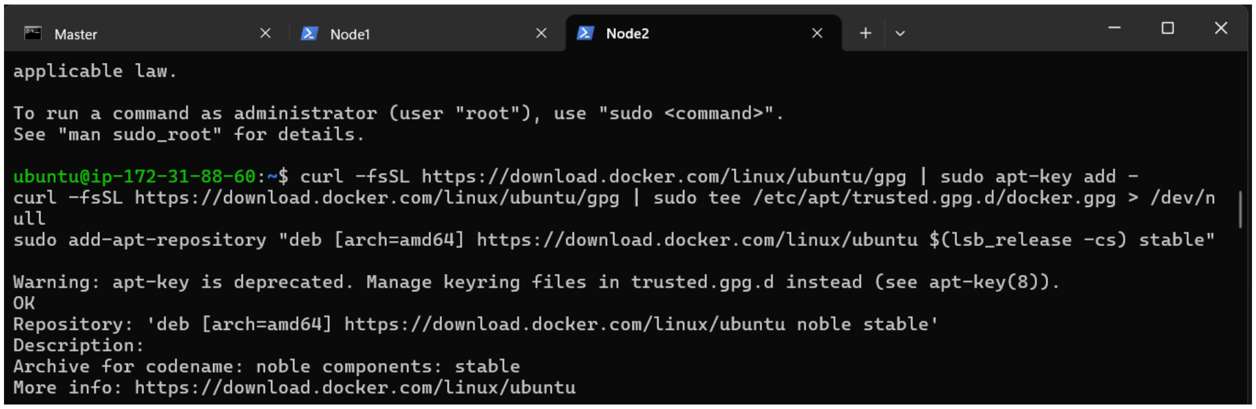
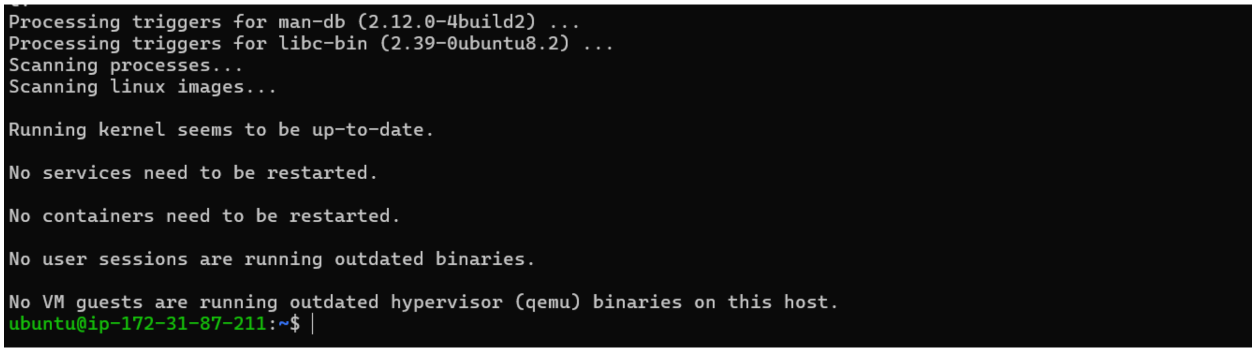
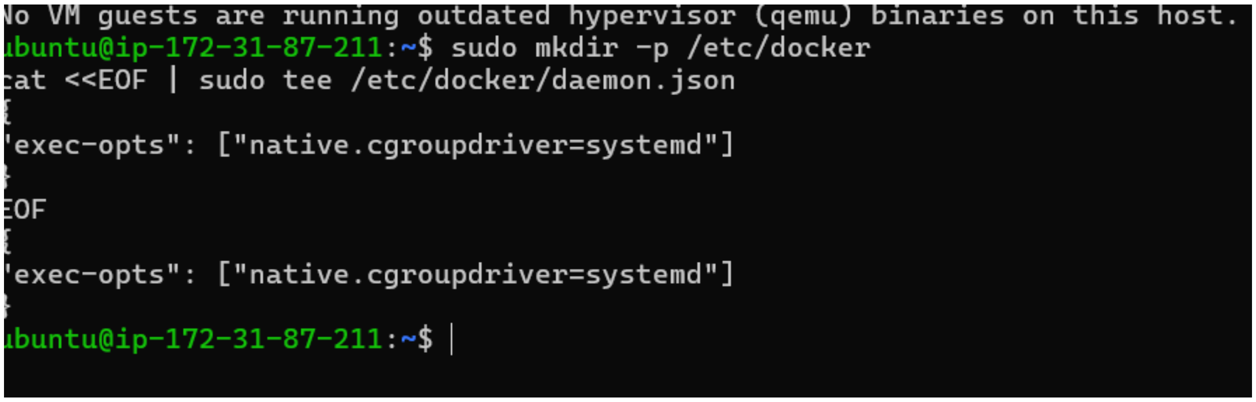


```
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-88-60:~$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo tee /etc/apt/trusted.gpg.d/docker.gpg > /dev/n
ull
sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"

Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
OK
Repository: 'deb [arch=amd64] https://download.docker.com/linux/ubuntu noble stable'
Description:
Archive for codename: noble components: stable
More info: https://download.docker.com/linux/ubuntu
```

```
sudo apt-get update

sudo apt-get install -y docker-ce
```



```
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu8.2) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@ip-172-31-87-211:~$ |
```



```
No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@ip-172-31-87-211:~$ sudo mkdir -p /etc/docker
cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
ubuntu@ip-172-31-87-211:~$ |
```

```
sudo systemctl enable docker
```

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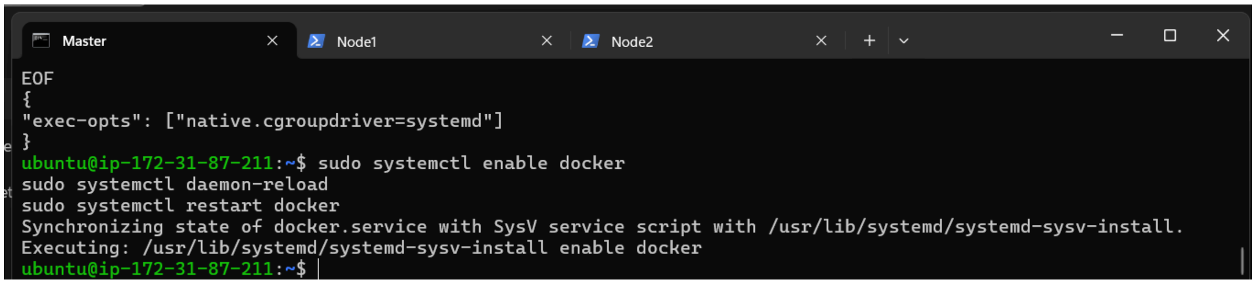
sudo systemctl daemon-reload

sudo systemctl restart docker



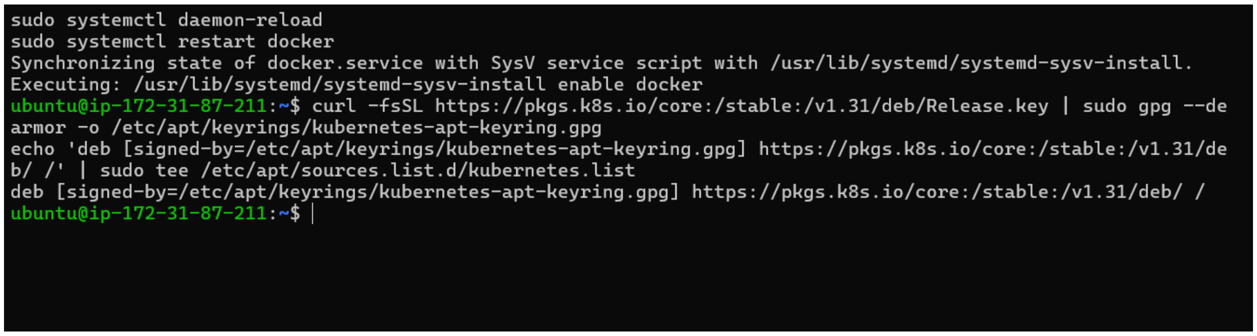
Master Node1 Node2

```
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
ubuntu@ip-172-31-87-211:~$ sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker
Synchronizing state of docker.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable docker
ubuntu@ip-172-31-87-211:~$
```

9. Run the below command to install Kubernets.

curl -fsSL https://pkgs.k8s.io/core:/stable:/v1.31/deb/Release.key | sudo gpg --dearmor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg

echo 'deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /' | sudo tee /etc/apt/sources.list.d/kubernetes.list



```
sudo systemctl daemon-reload
sudo systemctl restart docker
Synchronizing state of docker.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable docker
ubuntu@ip-172-31-87-211:~$ curl -fsSL https://pkgs.k8s.io/core:/stable:/v1.31/deb/Release.key | sudo gpg --de
armor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg
echo 'deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/de
b/ /' | sudo tee /etc/apt/sources.list.d/kubernetes.list
deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /
ubuntu@ip-172-31-87-211:~$
```

Run the commands:

sudo apt-get update

sudo apt-get install -y kubelet kubeadm kubectl

sudo apt-mark hold kubelet kubeadm kubectl

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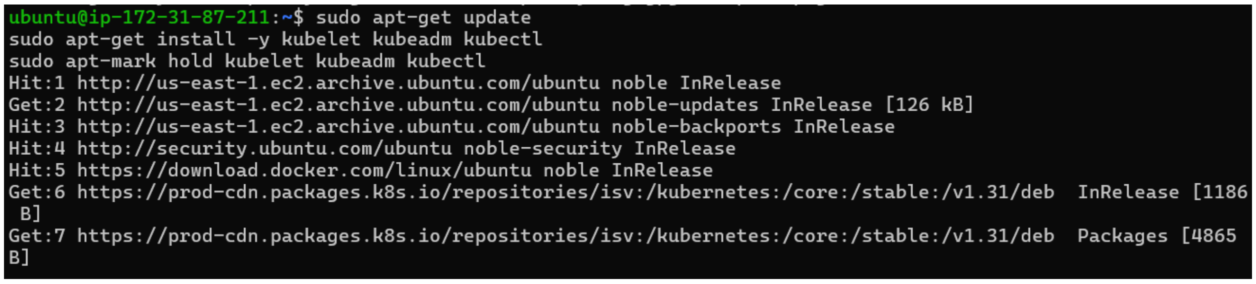
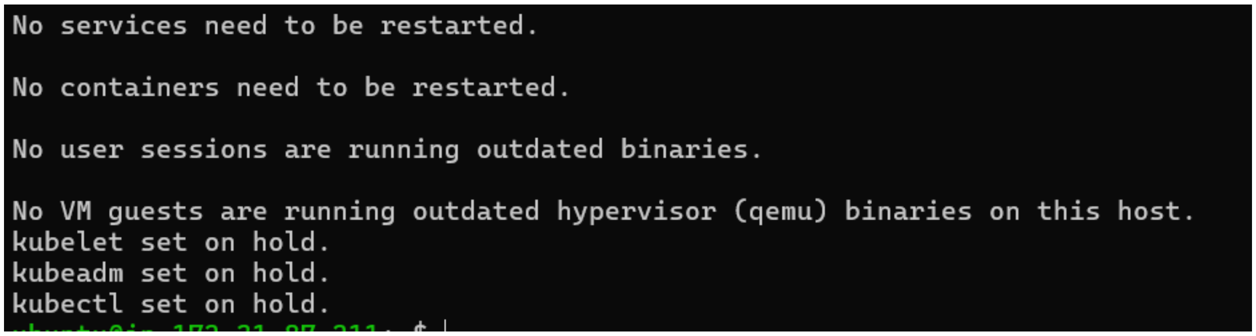


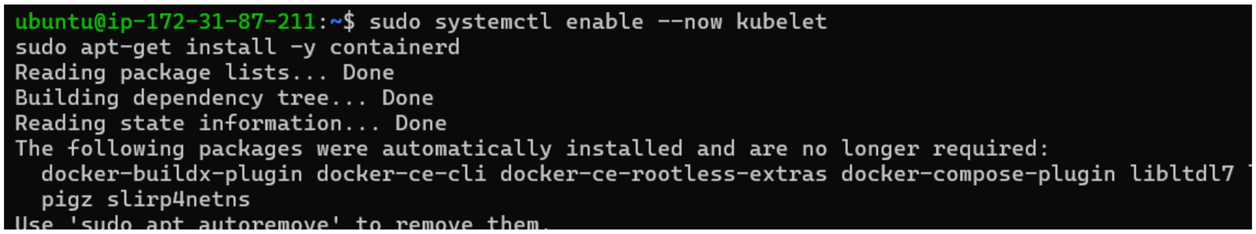
```
ubuntu@ip-172-31-87-211:~$ sudo apt-get update
sudo apt-get install -y kubelet kubeadm kubectl
sudo apt-mark hold kubelet kubeadm kubectl
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Hit:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:5 https://download.docker.com/linux/ubuntu noble InRelease
Get:6 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes:/core:/stable:/v1.31/deb  InRelease [1186
 B]
Get:7 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes:/core:/stable:/v1.31/deb  Packages [4865
B]
```



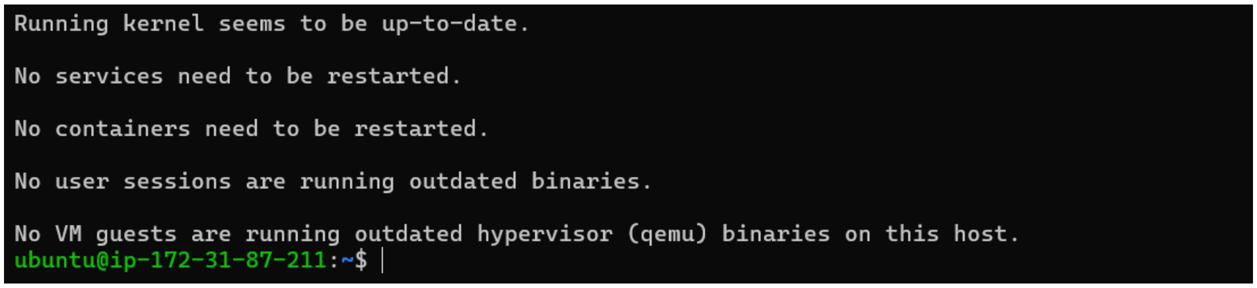
```
No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
```

sudo systemctl enable --now kubelet

sudo apt-get install -y containerd



```
ubuntu@ip-172-31-87-211:~$ sudo systemctl enable --now kubelet
sudo apt-get install -y containerd
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  docker-buildx-plugin docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7
  pigz slirp4netns
Use 'sudo apt autoremove' to remove them.
```



```
Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@ip-172-31-87-211:~$ |
```

sudo mkdir -p /etc/containerd

sudo containerd config default | sudo tee /etc/containerd/config.toml

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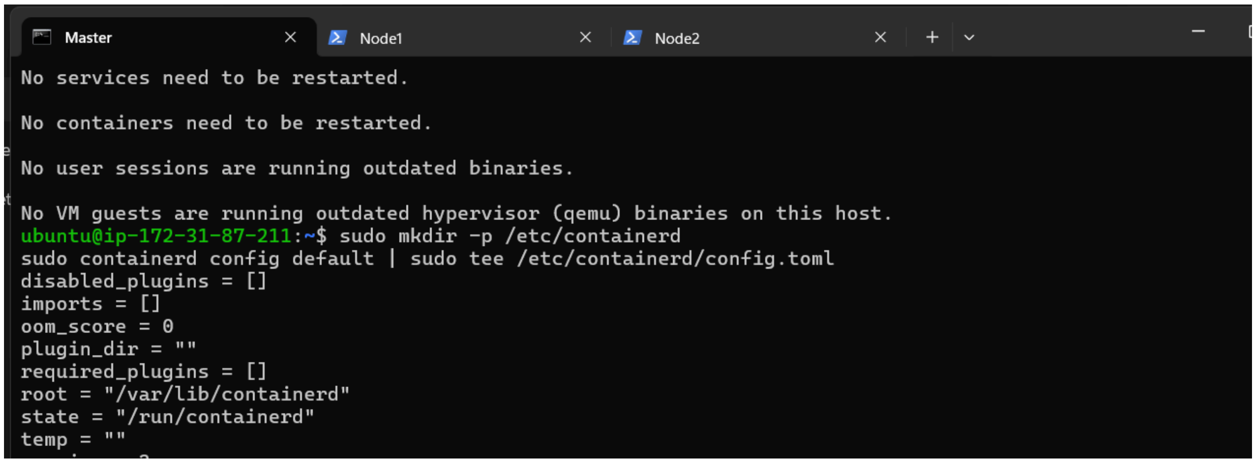
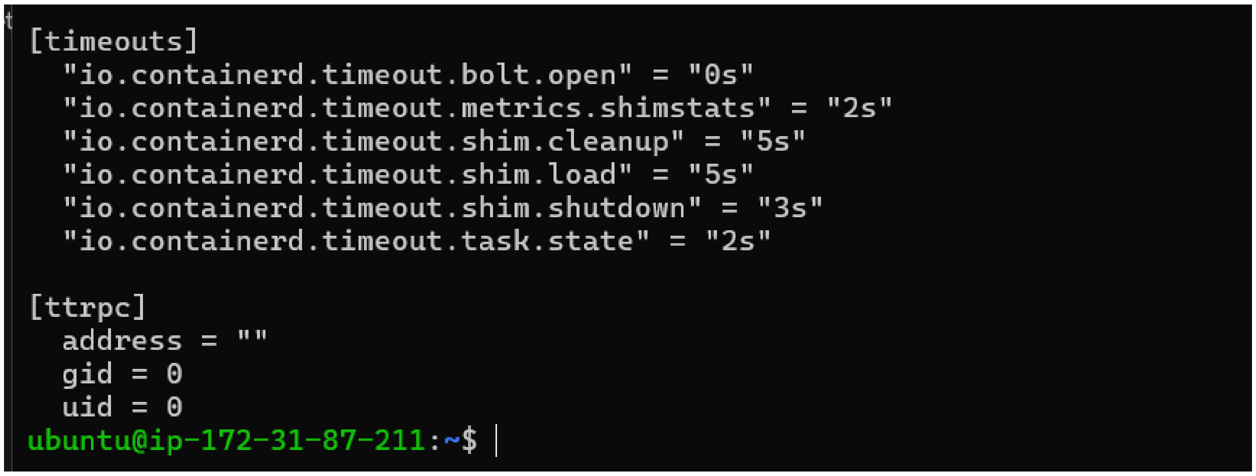

Master Node1 Node2

```
No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@ip-172-31-87-211:~$ sudo mkdir -p /etc/containerd
sudo containerd config default | sudo tee /etc/containerd/config.toml
disabled_plugins = []
imports = []
oom_score = 0
plugin_dir = ""
required_plugins = []
root = "/var/lib/containerd"
state = "/run/containerd"
temp = ""
```



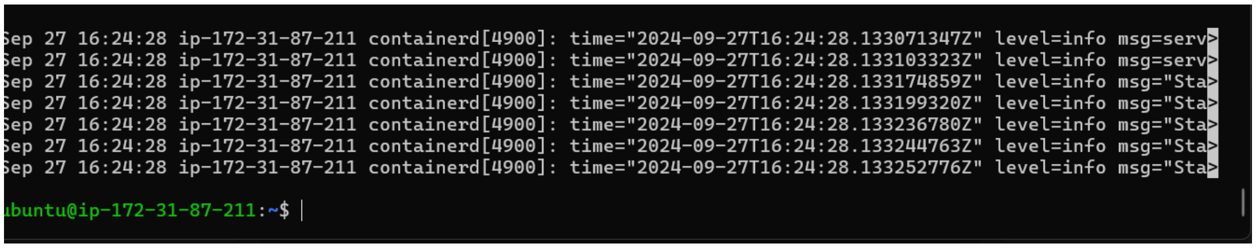
```
[timeouts]
  "io.containerd.timeout.bolt.open" = "0s"
  "io.containerd.timeout.metrics.shimstats" = "2s"
  "io.containerd.timeout.shim.cleanup" = "5s"
  "io.containerd.timeout.shim.load" = "5s"
  "io.containerd.timeout.shim.shutdown" = "3s"
  "io.containerd.timeout.task.state" = "2s"

[ttrpc]
  address = ""
  gid = 0
  uid = 0
ubuntu@ip-172-31-87-211:~$
```

```
sudo systemctl restart containerd

sudo systemctl enable containerd

sudo systemctl status containerd
```



```
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133071347Z" level=info msg=serv>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133103323Z" level=info msg=serv>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133174859Z" level=info msg="Sta>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133199320Z" level=info msg="Sta>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133236780Z" level=info msg="Sta>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133244763Z" level=info msg="Sta>
Sep 27 16:24:28 ip-172-31-87-211 containerd[4900]: time="2024-09-27T16:24:28.133252776Z" level=info msg="Sta>

ubuntu@ip-172-31-87-211:~$
```

exit with ctrl+c.

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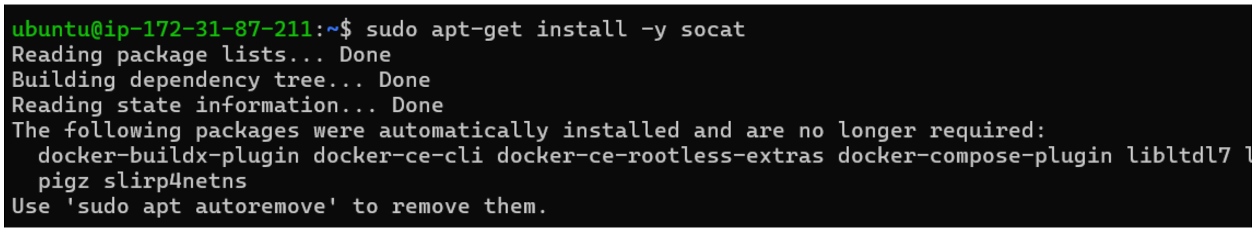
sudo apt-get install -y socat



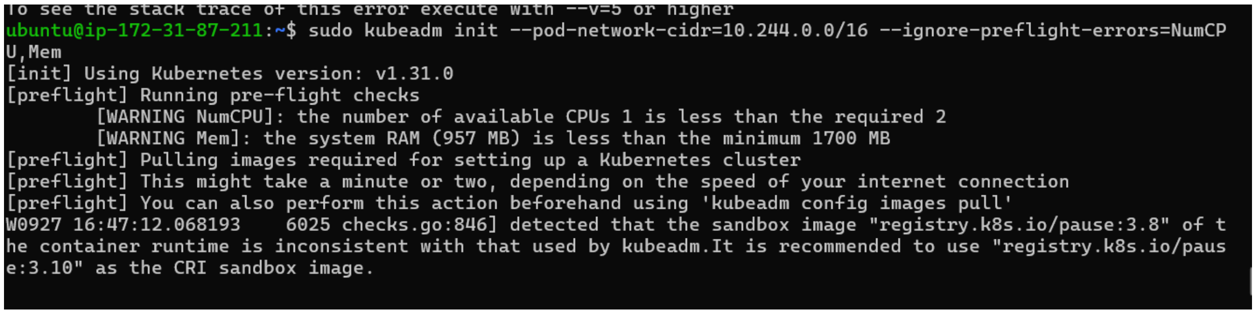
```
ubuntu@ip-172-31-87-211:~$ sudo apt-get install -y socat
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  docker-buildx-plugin docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7 l
  pigz slirp4netns
Use 'sudo apt autoremove' to remove them.
```

Run the following command in master only:

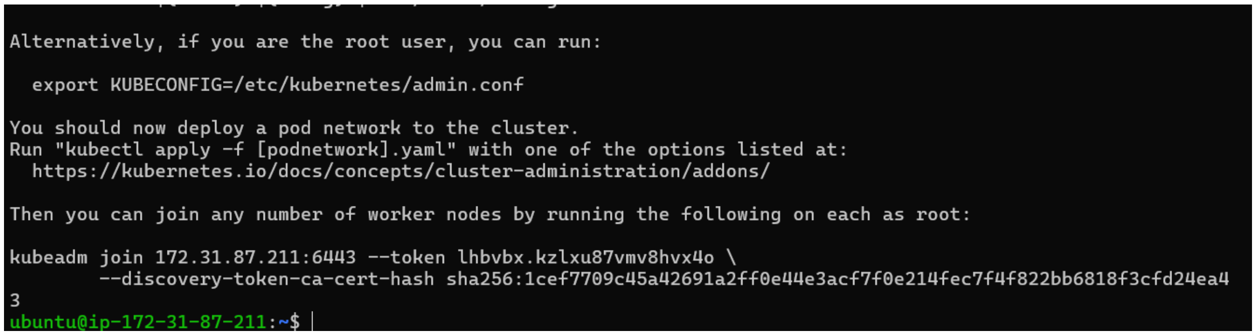
sudo kubeadm init --pod-network-cidr=10.244.0.0/16

if it gives error use:

sudo kubeadm init --pod-network-cidr=10.244.0.0/16 --ignore-preflight-errors=NumCPU,Mem



```
To see the stack trace of this error execute with --v=5 or higher
ubuntu@ip-172-31-87-211:~$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16 --ignore-preflight-errors=NumCP
U,Mem
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
        [WARNING NumCPU]: the number of available CPUs 1 is less than the required 2
        [WARNING Mem]: the system RAM (957 MB) is less than the minimum 1700 MB
[preflight] Pulling images required for setting up a Kubernetes cluster
[preflight] This might take a minute or two, depending on the speed of your internet connection
[preflight] You can also perform this action beforehand using 'kubeadm config images pull'
W0927 16:47:12.068193    6025 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.8" of t
he container runtime is inconsistent with that used by kubeadm.It is recommended to use "registry.k8s.io/paus
e:3.10" as the CRI sandbox image.
```



```
Alternatively, if you are the root user, you can run:

  export KUBECONFIG=/etc/kubernetes/admin.conf

You should now deploy a pod network to the cluster.
Run "kubectl apply -f [podnetwork].yaml" with one of the options listed at:
  https://kubernetes.io/docs/concepts/cluster-administration/addons/

Then you can join any number of worker nodes by running the following on each as root:

kubeadm join 172.31.87.211:6443 --token lhbvbx.kzlxu87vmv8hvx4o \
        --discovery-token-ca-cert-hash sha256:1cef7709c45a42691a2ff0e44e3acf7f0e214fec7f4f822bb6818f3cfd24ea4
3
ubuntu@ip-172-31-87-211:~$ |
```

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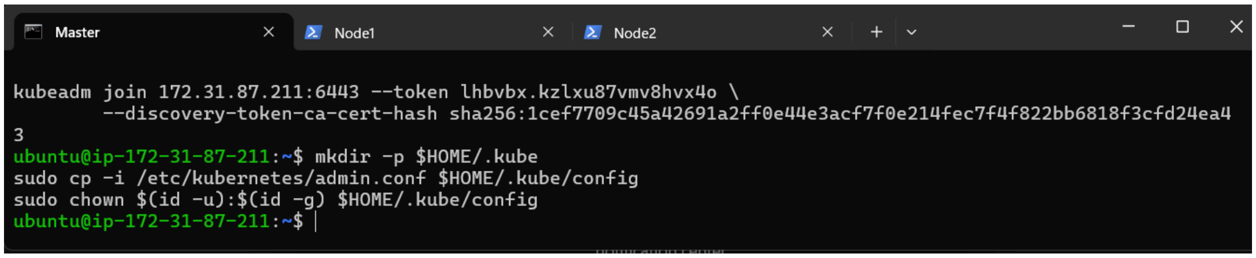
Token and ca

Note: copy the text after kubeadm that you see at the later part like below:

```
kubeadm join 172.31.87.211:6443 --token lhbvbx.kzlxu87vmv8hvx4o \

        --discovery-token-ca-cert-hash
sha256:1cef7709c45a42691a2ff0e44e3acf7f0e214fec7f4f822bb6818f3cfd24ea43
```

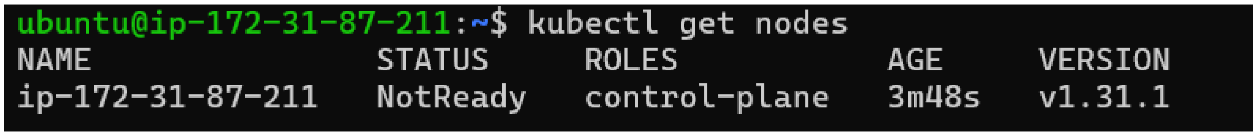
Run this command on master

```
mkdir -p $HOME/.kube

sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config

sudo chown $(id -u):$(id -g) $HOME/.kube/config
```



```
kubeadm join 172.31.87.211:6443 --token lhbvbx.kzlxu87vmv8hvx4o \
        --discovery-token-ca-cert-hash sha256:1cef7709c45a42691a2ff0e44e3acf7f0e214fec7f4f822bb6818f3cfd24ea4
3
ubuntu@ip-172-31-87-211:~$ mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
ubuntu@ip-172-31-87-211:~$
```

Now Run the command `kubectl get nodes` to see the nodes before executing Join command on nodes.

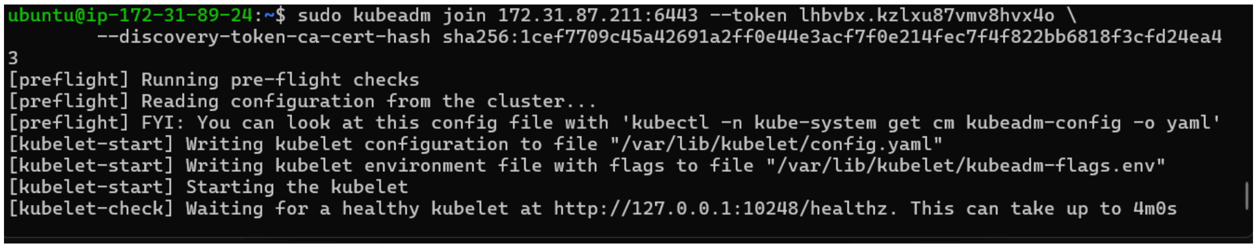


```
ubuntu@ip-172-31-87-211:~$ kubectl get nodes
NAME               STATUS     ROLES           AGE     VERSION
ip-172-31-87-211   NotReady   control-plane   3m48s   v1.31.1
```

Now paste the token and ca that I asked to copy earlier, on both the nodes.
use sudo before them.

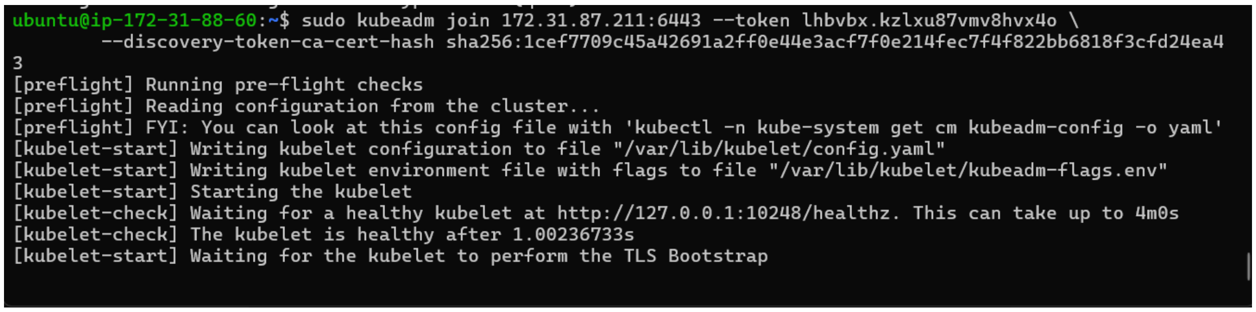
it would be something like:
sudo kubeadm join <your-master-node-ip>:6443 --token <your-token> --discovery-token-ca-cert-hash sha256:<your-ca-cert-hash>
(it has placeholders)

Node1:



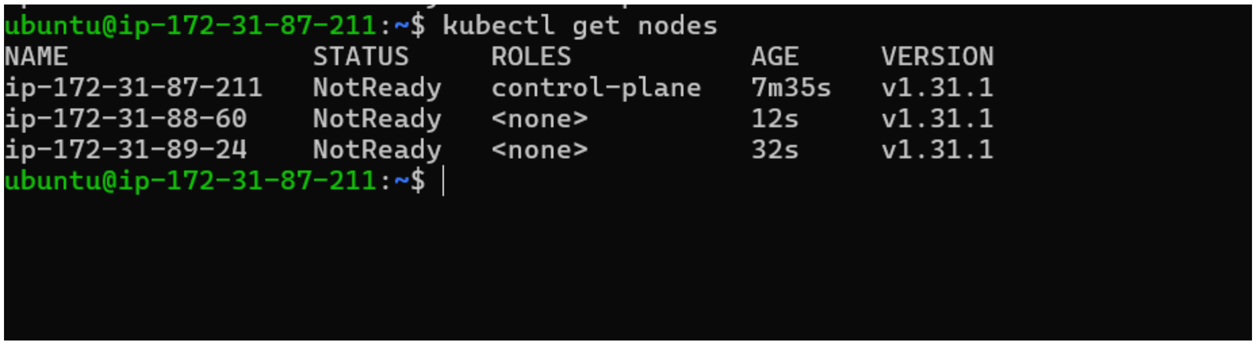
```
ubuntu@ip-172-31-89-24:~$ sudo kubeadm join 172.31.87.211:6443 --token lhbvbx.kzlxu87vmv8hvx4o \
        --discovery-token-ca-cert-hash sha256:1cef7709c45a42691a2ff0e44e3acf7f0e214fec7f4f822bb6818f3cfd24ea4
3
[preflight] Running pre-flight checks
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:10248/healthz. This can take up to 4m0s
```

Node2:



```
ubuntu@ip-172-31-88-60:~$ sudo kubeadm join 172.31.87.211:6443 --token lhbvbx.kzlxu87vmv8hvx4o \
        --discovery-token-ca-cert-hash sha256:1cef7709c45a42691a2ff0e44e3acf7f0e214fec7f4f822bb6818f3cfd24ea4
3
[preflight] Running pre-flight checks
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:10248/healthz. This can take up to 4m0s
[kubelet-check] The kubelet is healthy after 1.00236733s
[kubelet-start] Waiting for the kubelet to perform the TLS Bootstrap
```

Step 9: Now Run the command on Master **kubectl get nodes** to see the nodes after executing Join command on nodes.



```
ubuntu@ip-172-31-87-211:~$ kubectl get nodes
NAME               STATUS     ROLES           AGE     VERSION
ip-172-31-87-211   NotReady   control-plane   7m35s   v1.31.1
ip-172-31-88-60    NotReady   <none>          12s     v1.31.1
ip-172-31-89-24    NotReady   <none>          32s     v1.31.1
ubuntu@ip-172-31-87-211:~$ |
```

Step 10: Since Status is NotReady we have to add a network plugin. And also we have to give

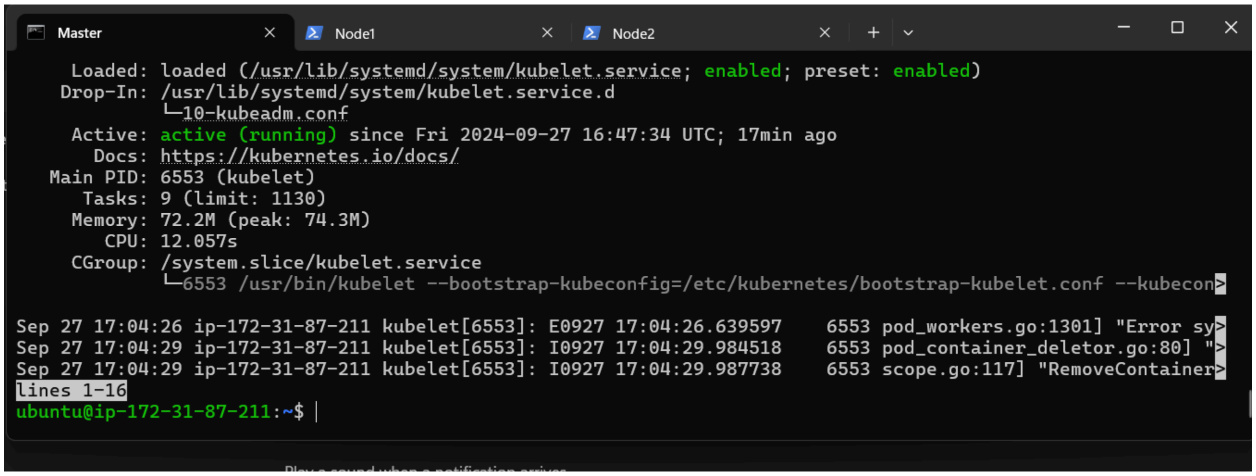
the name to the nodes.

paste this command on master terminal. (and the following commands will be based on master unless states otherwise.

kubectl apply -f https://docs.projectcalico.org/manifests/calico.yaml

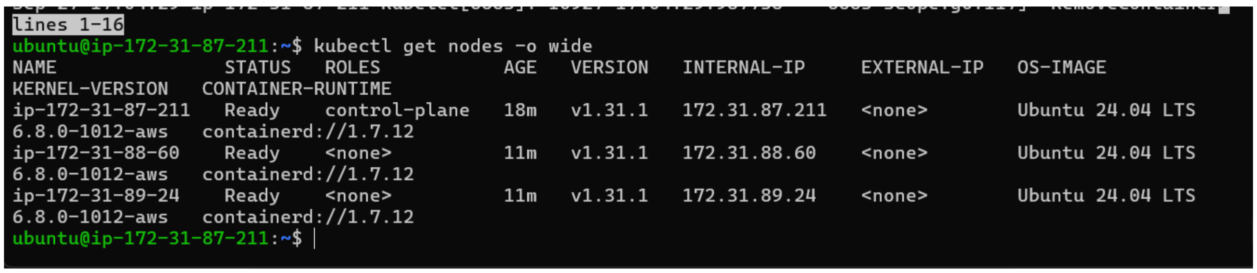
sudo systemctl status kubelet

again use ctrl+c to exit.



```
     Loaded: loaded (/usr/lib/systemd/system/kubelet.service; enabled; preset: enabled)
    Drop-In: /usr/lib/systemd/system/kubelet.service.d
             └─10-kubeadm.conf
     Active: active (running) since Fri 2024-09-27 16:47:34 UTC; 17min ago
       Docs: https://kubernetes.io/docs/
   Main PID: 6553 (kubelet)
      Tasks: 9 (limit: 1130)
     Memory: 72.2M (peak: 74.3M)
        CPU: 12.057s
     CGroup: /system.slice/kubelet.service
             └─6553 /usr/bin/kubelet --bootstrap-kubeconfig=/etc/kubernetes/bootstrap-kubelet.conf --kubecon>

Sep 27 17:04:26 ip-172-31-87-211 kubelet[6553]: E0927 17:04:26.639597    6553 pod_workers.go:1301] "Error sy>
Sep 27 17:04:29 ip-172-31-87-211 kubelet[6553]: I0927 17:04:29.984518    6553 pod_container_deletor.go:80] ">
Sep 27 17:04:29 ip-172-31-87-211 kubelet[6553]: I0927 17:04:29.987738    6553 scope.go:117] "RemoveContainer>
lines 1-16
ubuntu@ip-172-31-87-211:~$ |
```

Now Run command **kubectl get nodes -o wide** we can see Status is ready.



```
lines 1-16
ubuntu@ip-172-31-87-211:~$ kubectl get nodes -o wide
NAME               STATUS   ROLES           AGE   VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE
KERNEL-VERSION   CONTAINER-RUNTIME
ip-172-31-87-211   Ready    control-plane   18m   v1.31.1   172.31.87.211   <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ip-172-31-88-60    Ready    <none>          11m   v1.31.1   172.31.88.60    <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ip-172-31-89-24    Ready    <none>          11m   v1.31.1   172.31.89.24    <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ubuntu@ip-172-31-87-211:~$ |
```

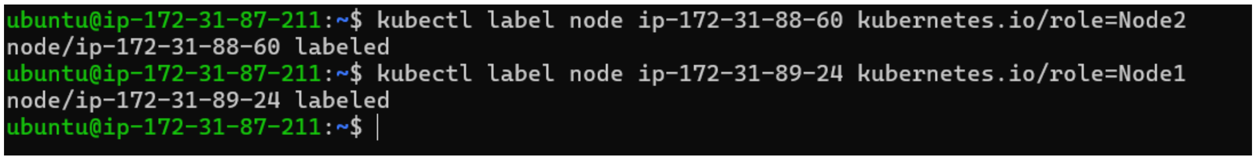
Now to Rename run this command

Syntax: kubectl label node <node-ip> kubernetes.io/role=worker

examples:

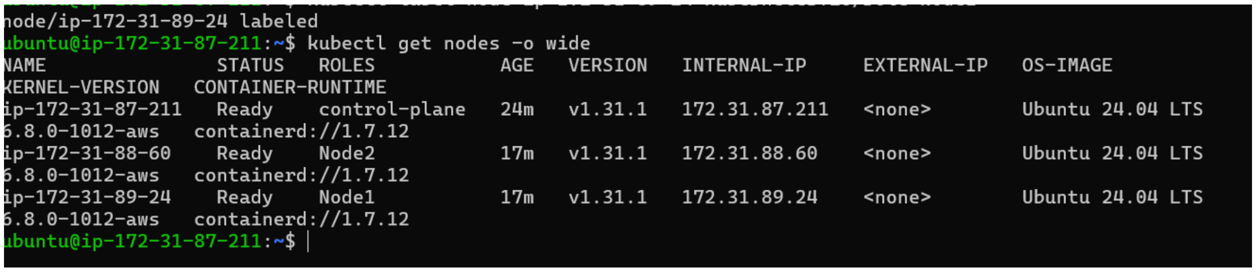
Rename to Node 1:kubectl label node ip-<node1ip> kubernetes.io/role=Node1

Rename to Node 2:kubectl label node ip-<node2ip> kubernetes.io/role=Node2



```
ubuntu@ip-172-31-87-211:~$ kubectl label node ip-172-31-88-60 kubernetes.io/role=Node2
node/ip-172-31-88-60 labeled
ubuntu@ip-172-31-87-211:~$ kubectl label node ip-172-31-89-24 kubernetes.io/role=Node1
node/ip-172-31-89-24 labeled
ubuntu@ip-172-31-87-211:~$ |
```

Step 11: Run command kubectl get nodes -o wide . And Hence we can see we have Successfully connected Node 1 and Node 2 to the Master.



```
node/ip-172-31-89-24 labeled
ubuntu@ip-172-31-87-211:~$ kubectl get nodes -o wide
NAME               STATUS   ROLES           AGE   VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE
KERNEL-VERSION   CONTAINER-RUNTIME
ip-172-31-87-211   Ready    control-plane   24m   v1.31.1   172.31.87.211   <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ip-172-31-88-60    Ready    Node2           17m   v1.31.1   172.31.88.60    <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ip-172-31-89-24    Ready    Node1           17m   v1.31.1   172.31.89.24    <none>        Ubuntu 24.04 LTS
6.8.0-1012-aws   containerd://1.7.12
ubuntu@ip-172-31-87-211:~$ |
```

Name:Shubham Jha D15C Roll. No 19

Conclusion:

In this Advanced DevOps Lab experiment, we began by setting up three EC2 Ubuntu instances
on AWS, designating one as the Master node and the others as Worker nodes.
We then installed Docker and Kubernetes on all instances, ensuring Docker was properly configured.
The Kubernetes cluster was initialized on the Master node, and the Flannel networking plugin
was applied to facilitate communication between nodes.
Finally, we joined the Worker nodes to the cluster using the provided token and hash, resulting in a fully operational Kubernetes cluster ready for managing and scaling containerized applications.