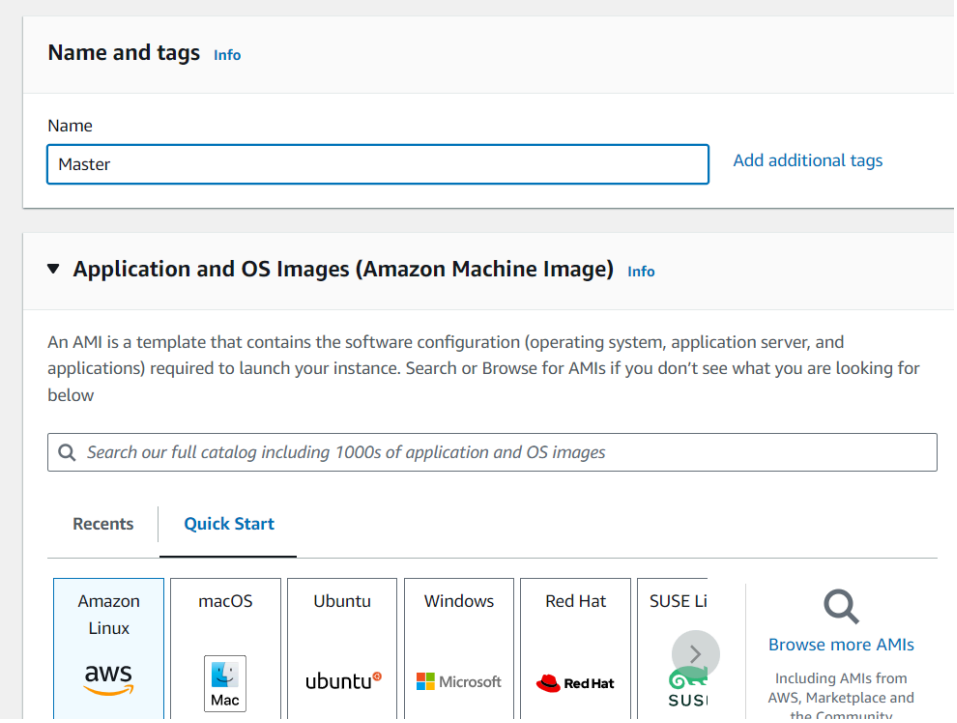
Name:Atharv Sanjay Nikam **Div:D15C** **Roll:36**

Experiment 3

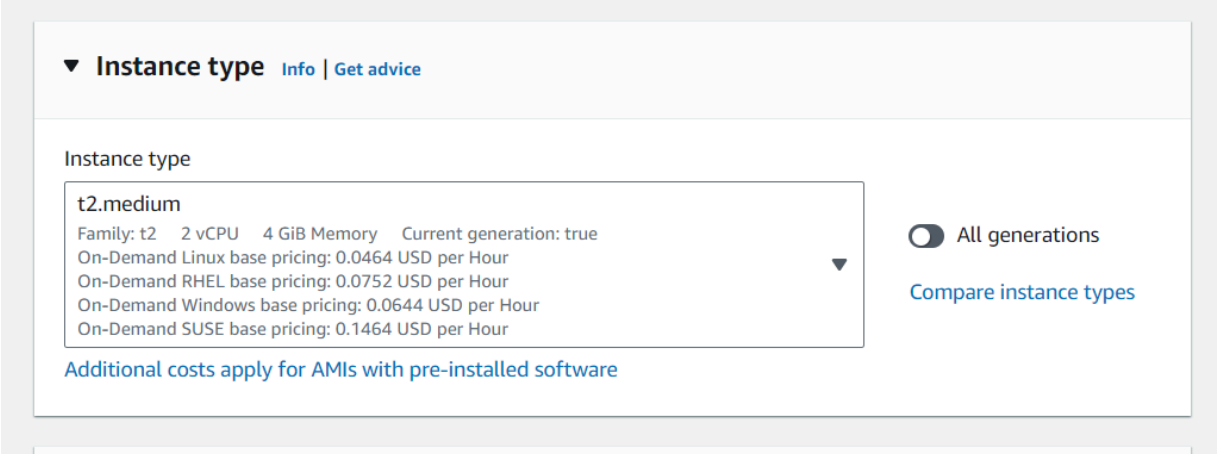
Aim: To install Kubectl and execute Kubectl commands to manage the Kubernetes cluster and deploy Your First Kubernetes Application.

1)Launch an EC2 Instance:

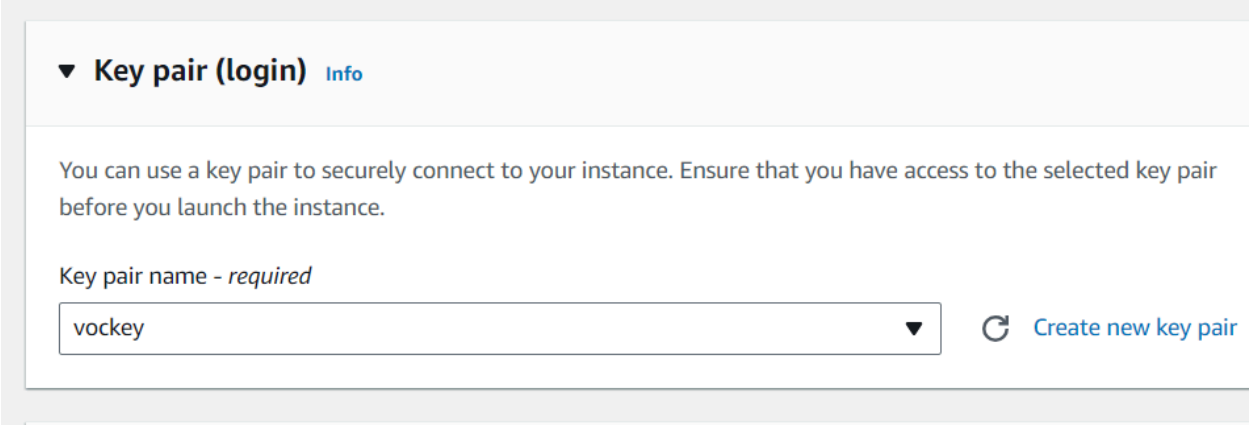
Choose Amazon Linux as the operating system for your instance.



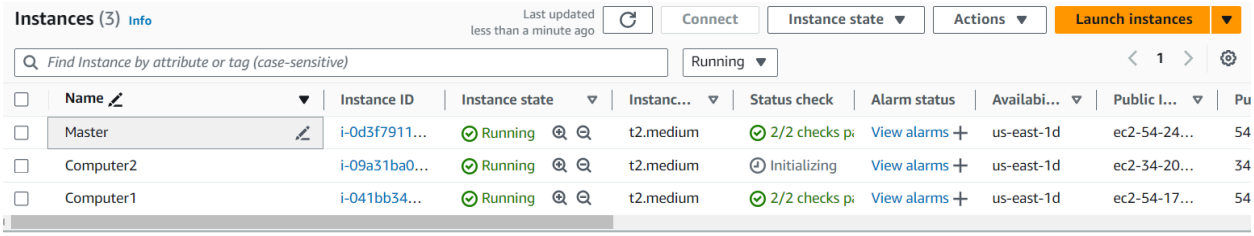
Note: The AWS free tier provides a t2.micro instance (1 CPU, 1 GiB RAM), but Kubernetes requires a minimum of 2 CPUs and 2 GiB RAM. So, make sure to select **t2.medium**

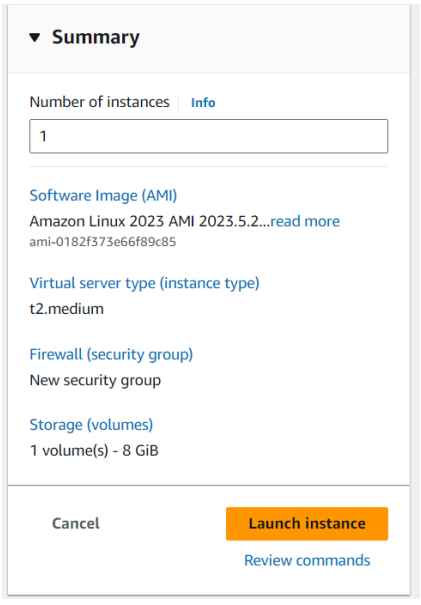


2)select a Key Pair:
You can either use the default key pair provided by AWS or create a new one for better security. Click on **Create**.



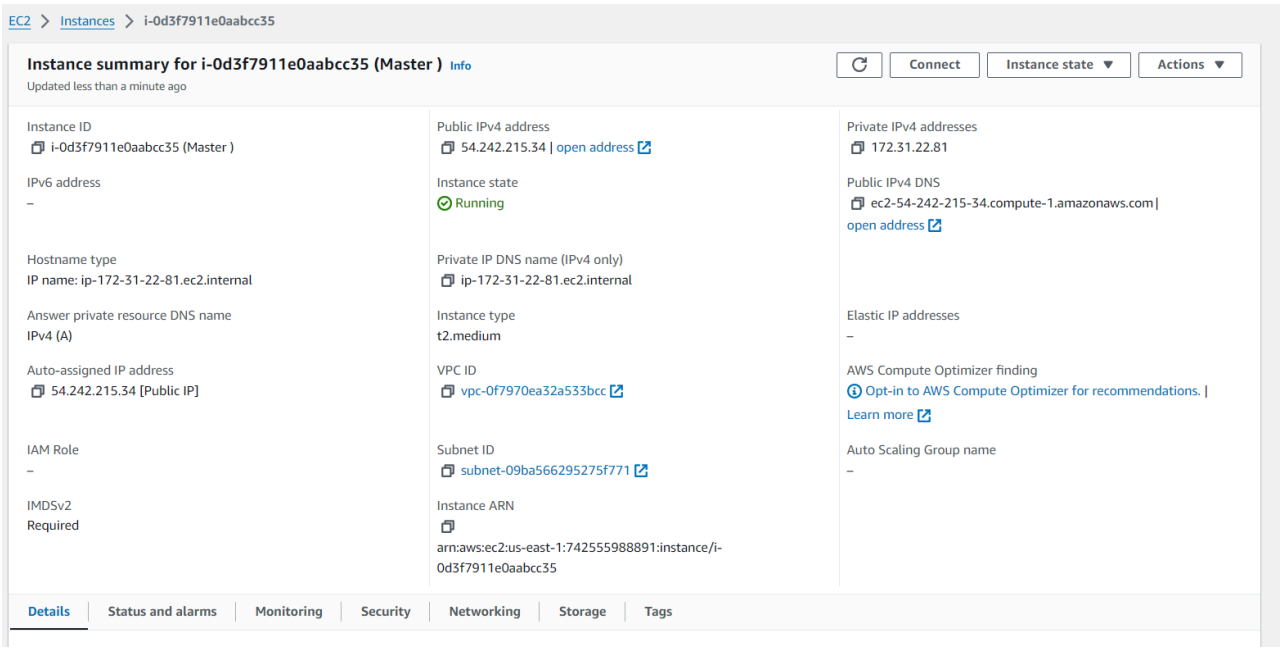
All your instances will appear here

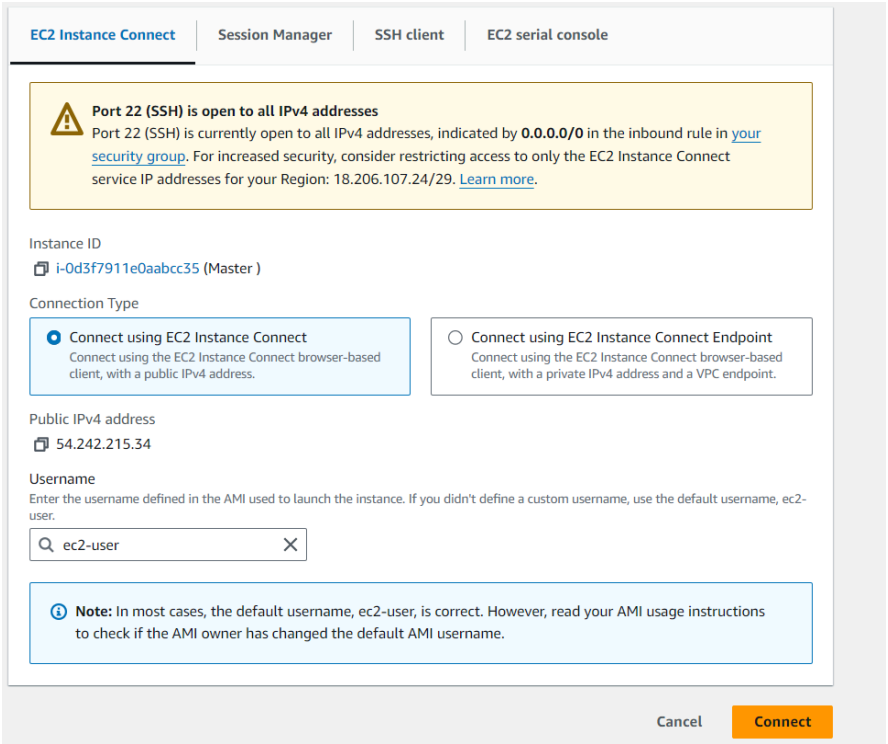




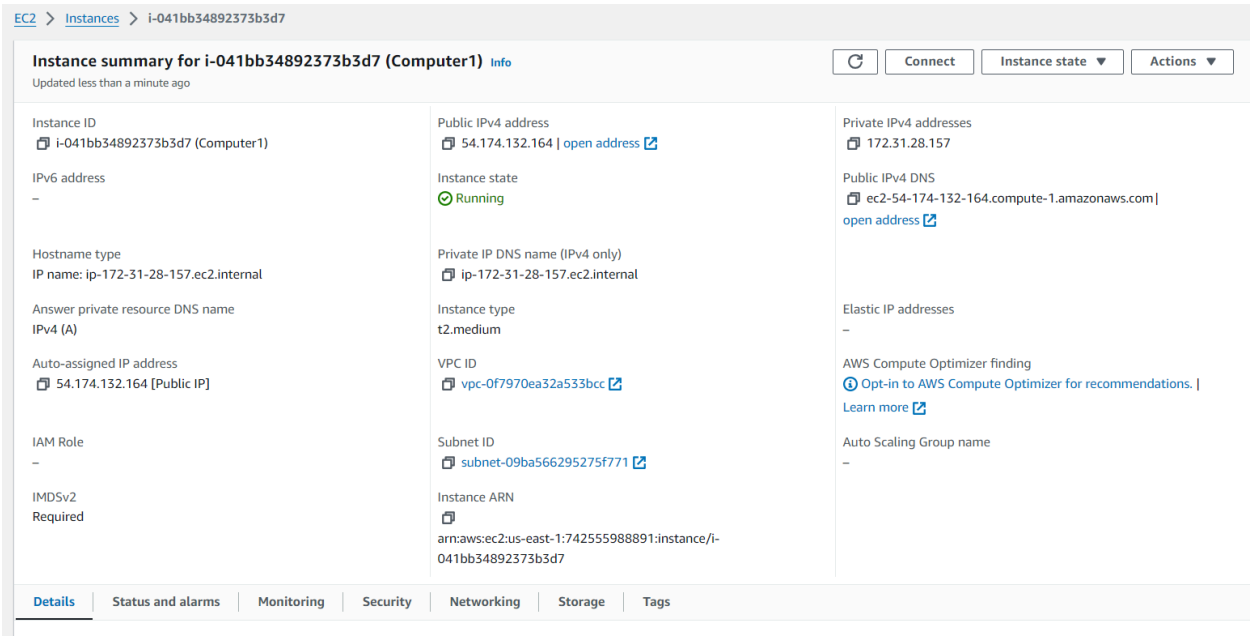
3)Connect to the Instance:

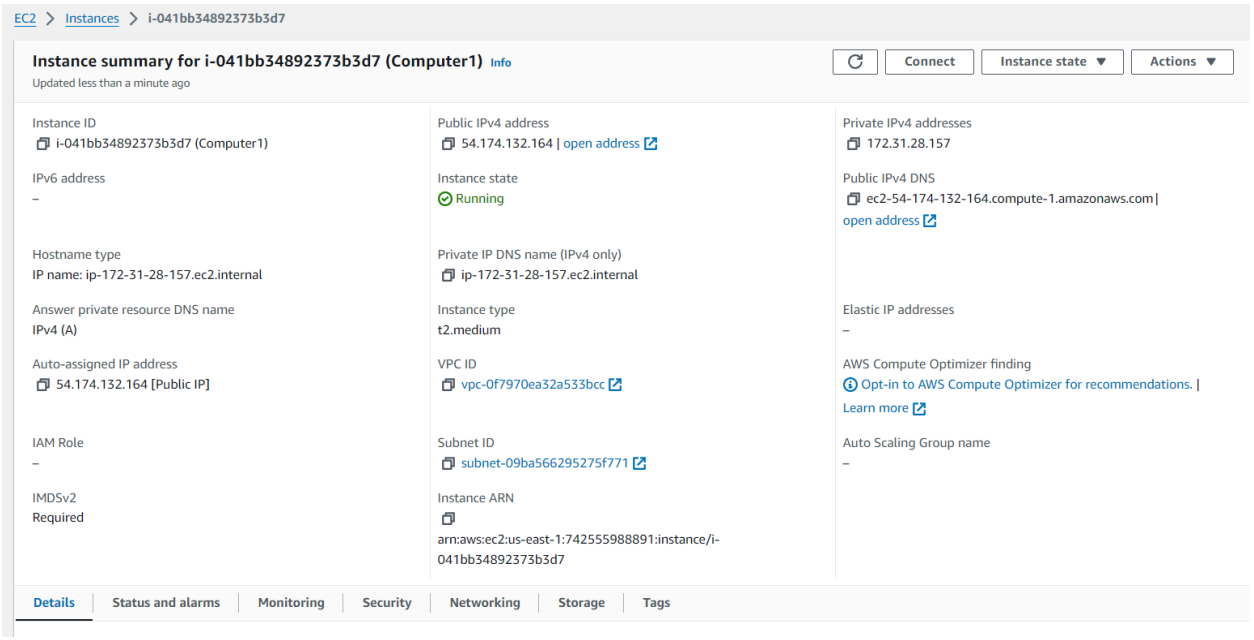
Navigate to the instances page, locate your instance, and click on its ID. Then, select **Connect** and keep the default connection settings. Finally, click **Connect** to start your session.





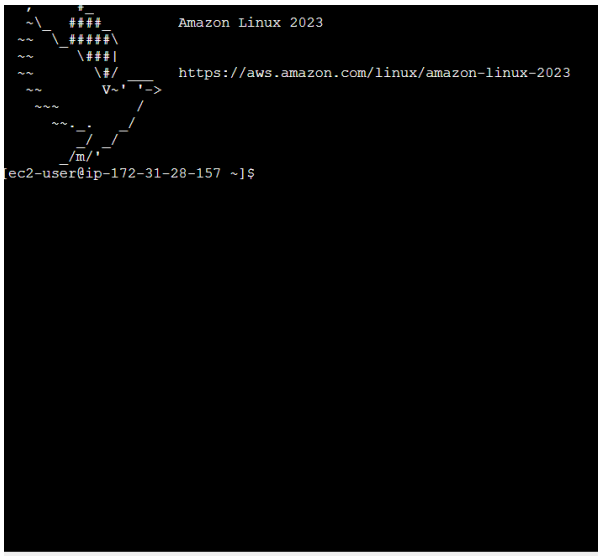
Name:Atharv Sanjay Nikam **Div:D15C** **Roll:36**



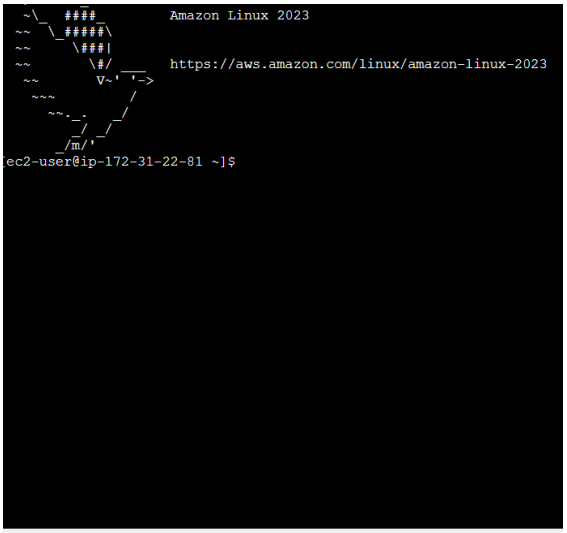


Name:Atharv Sanjay Nikam **Dlv:D15C** **Roll:36**

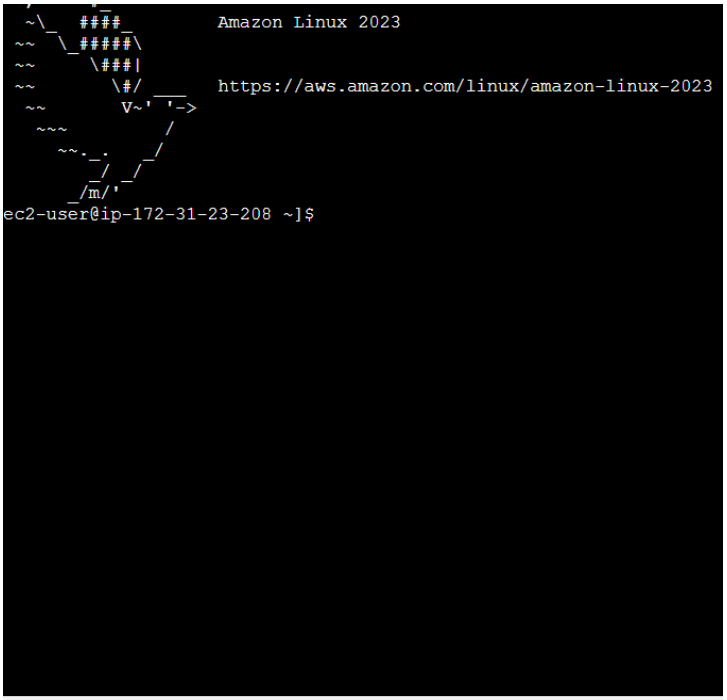
All the three server



i-041bb34892373b3d7 (Computer1)
PublicIPs: 54.174.132.164 PrivateIPs: 172.31.28.157



i-0d3f7911e0aabcc35 (Master)
PublicIPs: 54.242.215.34 PrivateIPs: 172.31.22.81



i-09a31ba0572c10bdb (Computer2)
PublicIPs: 34.204.51.153 PrivateIPs: 172.31.23.208

Name:Atharv Sanjay Nikam **Div:D15C** **Roll:36**

Step 2: Installation of Docker

1)Switch to Root User:

Run `sudo su` to get root-level access in the terminal.

```
[ec2-user@ip-172-31-22-81 ~]$ sudo su
[root@ip-172-31-22-81 ec2-user]#
```

2)Install Docker:

Use the YUM package manager to install Docker by running:

```
yum install docker -y
```

```
[root@ip-172-31-22-81 ec2-user]# yum install docker -y
Last metadata expiration check: 0:11:19 ago on Sun Sep 15 06:50:06 2024.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                    Repository  Size
================================================================================
Installing:
 docker                  x86_64        25.0.6-1.amzn2023.0.2      amazonlinux  44 M
Installing dependencies:
 containerd              x86_64        1.7.20-1.amzn2023.0.1      amazonlinux  35 M
 iptables-libs           x86_64        1.8.8-3.amzn2023.0.2       amazonlinux 401 k
 iptables-nft            x86_64        1.8.8-3.amzn2023.0.2       amazonlinux 183 k
 libcgroup               x86_64        3.0-1.amzn2023.0.1         amazonlinux  75 k
 libnetfilter_conntrack  x86_64        1.0.8-2.amzn2023.0.2       amazonlinux  58 k
 libnfnetlink            x86_64        1.0.1-19.amzn2023.0.2      amazonlinux  30 k
 libnftnl                x86_64        1.2.2-2.amzn2023.0.2       amazonlinux  84 k
 pigz                    x86_64        2.5-1.amzn2023.0.3         amazonlinux  83 k
 runc                    x86_64        1.1.13-1.amzn2023.0.1      amazonlinux 3.2 M

Transaction Summary
================================================================================
Install  10 Packages

Total download size: 84 M
Installed size: 317 M
Downloading Packages:
(1/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm      6.3 MB/s | 401 kB     00:00
(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm       6.0 MB/s | 183 kB     00:00
(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm            2.8 MB/s |  75 kB     00:00
```

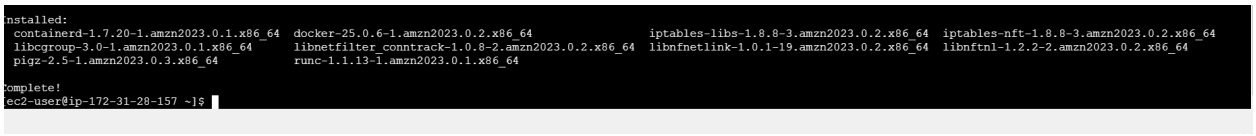
```
Install  10 Packages

Total download size: 84 M
Installed size: 317 M
Downloading Packages:
(1/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm      6.3 MB/s | 401 kB     00:00
(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm       6.0 MB/s | 183 kB     00:00
(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm            2.8 MB/s |  75 kB     00:00
(4/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64.rpm 2.6 MB/s |  58 kB     00:00
(5/10): libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64.rpm      1.4 MB/s |  30 kB     00:00
(6/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm           1.9 MB/s |  84 kB     00:00
(7/10): pigz-2.5-1.amzn2023.0.3.x86_64.rpm                 1.1 MB/s |  83 kB     00:00
(8/10): runc-1.1.13-1.amzn2023.0.1.x86_64.rpm               22 MB/s | 3.2 MB     00:00
(9/10): containerd-1.7.20-1.amzn2023.0.1.x86_64.rpm         41 MB/s |  35 MB     00:00
(10/10): docker-25.0.6-1.amzn2023.0.2.x86_64.rpm            38 MB/s |  44 MB     00:01
--------------------------------------------------------------------------------
Total                                                       70 MB/s |  84 MB     00:01
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :                                                        1/1
  Installing       : runc-1.1.13-1.amzn2023.0.1.x86_64                      1/10
  Installing       : containerd-1.7.20-1.amzn2023.0.1.x86_64                2/10
  Running scriptlet: containerd-1.7.20-1.amzn2023.0.1.x86_64                2/10
  Installing       : pigz-2.5-1.amzn2023.0.3.x86_64                         3/10
  Installing       : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                   4/10
  Installing       : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64              5/10
  Installing       : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64     6/10
  Installing       : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64              7/10
  Installing       : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64               8/10
  Running scriptlet: iptables-nft-1.8.8-3.amzn2023.0.2.x86_64               8/10
  Installing       : libcgroup-3.0-1.amzn2023.0.1.x86_64                    9/10
  Running scriptlet: docker-25.0.6-1.amzn2023.0.2.x86_64                    10/10
  Installing       : docker-25.0.6-1.amzn2023.0.2.x86_64                    10/10
  Running scriptlet: docker-25.0.6-1.amzn2023.0.2.x86_64                    10/10
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /usr/lib/systemd/system/docker.socket.
```

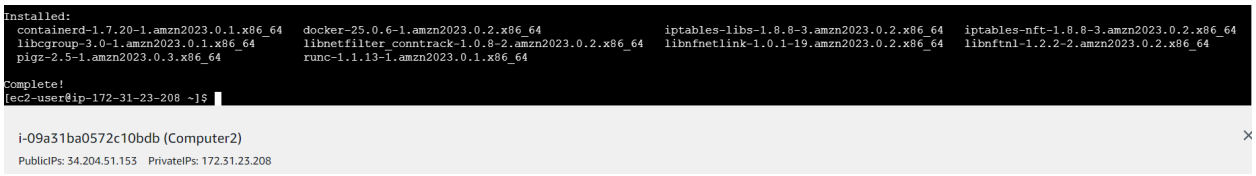
Name:Atharv Sanjay Nikam **Div:D15C** **Roll:36**

3)Install in all devices

Computer 1



Computer2



4)Configure Docker Daemon:

You need to configure Docker to use the systemd cgroup driver.

Run the following commands:`cd /etc/docker`

```
cat <<EOF | sudo tee /etc/docker/daemon.json
{
  "exec-opts": ["native.cgroupdriver=systemd"],
  "log-driver": "json-file",
  "log-opts": {
    "max-size": "100m"
  },
  "storage-driver": "overlay2"
}
EOF
```

```
[root@ip-172-31-22-81 docker]# cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
```

5)Enable and Start Docker:

Start Docker by running:

bash

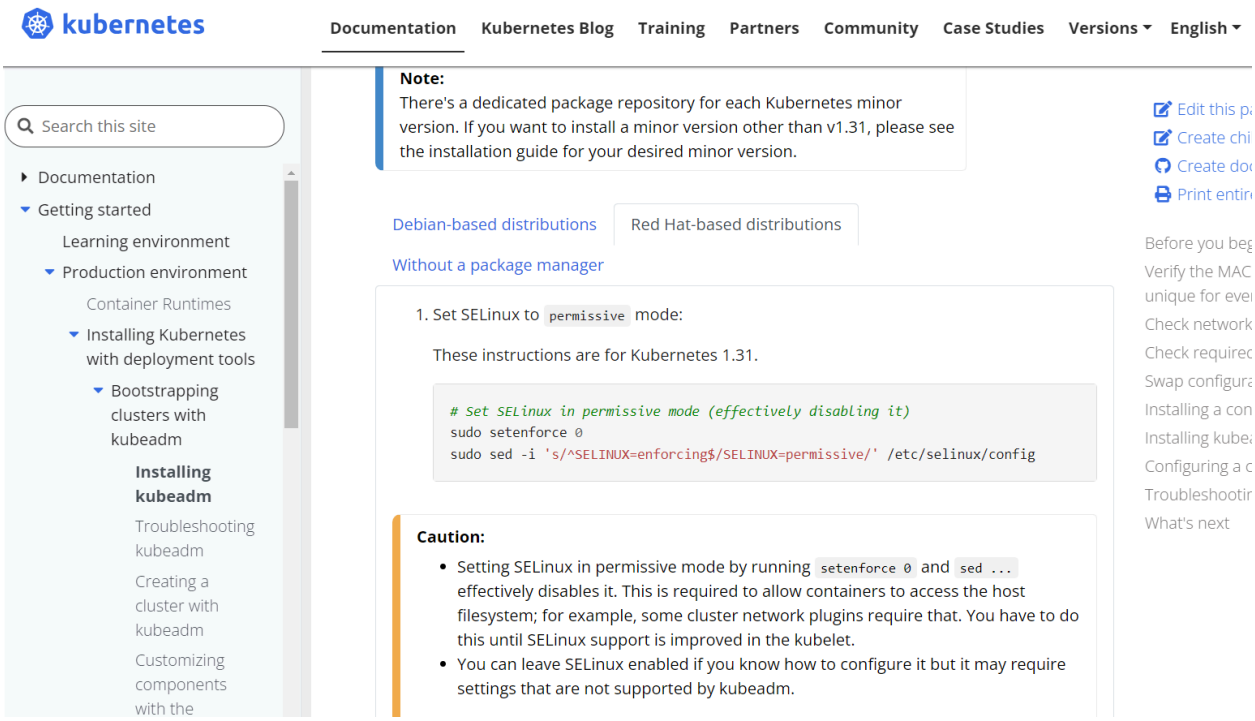
Copy code

```
sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker
```

```
[root@ip-172-31-22-81 docker]# sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker
docker -v
Docker version 25.0.5, build 5dc9bcc
[root@ip-172-31-22-81 docker]#
```

Step 3: Installing Kubernetes

For installing kubernetes, we will be using kubeadm, a framework used for creating kubernetes clusters using command line.
https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/install-kubeadm
The following will be visible when you visit the website.



1)Prepare the System:

Configure SELinux to run in permissive mode to avoid permission issues during the Kubernetes setup:

bash
Copy code

```
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/'
/etc/selinux/config
```

```
[root@ip-172-31-22-81 ec2-user]# sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[root@ip-172-31-22-81 ec2-user]#
```

Computer 1

```
[ec2-user@ip-172-31-28-157 ~]$ sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[ec2-user@ip-172-31-28-157 ~]$
```

Computer 2

```
[ec2-user@ip-172-31-23-208 ~]$ sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[ec2-user@ip-172-31-23-208 ~]$
```

2)Add the Kubernetes Repo:

Create a Kubernetes repository by running:

bash

Copy code

```
cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
```

```
[root@ip-172-31-22-81 ec2-user]# cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
[root@ip-172-31-22-81 ec2-user]#
```

i-0d3f7911e0aabcc35 (Master)

PublicIPs: 54.242.215.34 PrivateIPs: 172.31.22.81

```
[root@ip-172-31-22-81 ec2-user]# sudo yum update
Kubernetes                                              [===                                                ] ---  B/s |   0  B     --:-- ETA
Kubernetes                                                                                                    90 kB/s |  17 kB     00:00
Dependencies resolved.
Nothing to do.
Complete!
[root@ip-172-31-22-81 ec2-user]#
```

yum repolist

This command shows the repositories created on the machine.

```
[root@ip-172-31-22-81 ec2-user]# yum repolist
repo id                                                                repo name
amazonlinux                                                            Amazon Linux 2023 repository
kernel-livepatch                                                       Amazon Linux 2023 Kernel Livepatch repository
kubernetes                                                             Kubernetes
[root@ip-172-31-22-81 ec2-user]#
```

3)Install Kubernetes Components:

Now, install the required Kubernetes tools by executing:

bash

Copy code

```
sudo yum install -y kubelet kubeadm kubectl
--disableexcludes=kubernetes
```

```
[root@ip-172-31-22-81 ec2-user]# sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Last metadata expiration check: 0:03:06 ago on Sun Sep 15 07:47:07 2024.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                 Repository    Size
================================================================================
Installing:
 kubeadm                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubectl                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubelet                 x86_64        1.30.5-150500.1.1       kubernetes    17 M
Installing dependencies:
 conntrack-tools         x86_64        1.4.6-2.amzn2023.0.2    amazonlinux  208 k
 cri-tools               x86_64        1.30.1-150500.1.1       kubernetes   8.6 M
 kubernetes-cni          x86_64        1.4.0-150500.1.1        kubernetes   6.7 M
 libnetfilter_cthelper   x86_64        1.0.0-21.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_cttimeout  x86_64        1.0.0-19.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_queue      x86_64        1.0.5-2.amzn2023.0.2    amazonlinux   30 k

Transaction Summary
================================================================================
Install  9 Packages

Total download size: 53 M
Installed size: 292 M
Downloading Packages:
(1/9): libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64.rpm  432 kB/s |  24 kB  00:00
(2/9): libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64.rpm   374 kB/s |  24 kB  00:00
```

```
[ec2-user@ip-172-31-28-157 ~]$ sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Last metadata expiration check: 0:03:08 ago on Sun Sep 15 07:47:52 2024.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                 Repository    Size
================================================================================
Installing:
 kubeadm                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubectl                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubelet                 x86_64        1.30.5-150500.1.1       kubernetes    17 M
Installing dependencies:
 conntrack-tools         x86_64        1.4.6-2.amzn2023.0.2    amazonlinux  208 k
 cri-tools               x86_64        1.30.1-150500.1.1       kubernetes   8.6 M
 kubernetes-cni          x86_64        1.4.0-150500.1.1        kubernetes   6.7 M
 libnetfilter_cthelper   x86_64        1.0.0-21.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_cttimeout  x86_64        1.0.0-19.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_queue      x86_64        1.0.5-2.amzn2023.0.2    amazonlinux   30 k

Transaction Summary
================================================================================
Install  9 Packages

Total download size: 53 M
Installed size: 292 M
Downloading Packages:
(1/9): libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64.rpm  426 kB/s |  24 kB  00:00
```

```
[ec2-user@ip-172-31-23-208 ~]$ sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Last metadata expiration check: 0:03:07 ago on Sun Sep 15 07:47:58 2024.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                 Repository    Size
================================================================================
Installing:
 kubeadm                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubectl                 x86_64        1.30.5-150500.1.1       kubernetes    10 M
 kubelet                 x86_64        1.30.5-150500.1.1       kubernetes    17 M
Installing dependencies:
 conntrack-tools         x86_64        1.4.6-2.amzn2023.0.2    amazonlinux  208 k
 cri-tools               x86_64        1.30.1-150500.1.1       kubernetes   8.6 M
 kubernetes-cni          x86_64        1.4.0-150500.1.1        kubernetes   6.7 M
 libnetfilter_cthelper   x86_64        1.0.0-21.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_cttimeout  x86_64        1.0.0-19.amzn2023.0.2   amazonlinux   24 k
 libnetfilter_queue      x86_64        1.0.5-2.amzn2023.0.2    amazonlinux   30 k

Transaction Summary
================================================================================
Install  9 Packages

Total download size: 53 M
Installed size: 292 M
Downloading Packages:
(1/9): libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64.rpm  455 kB/s |  24 kB  00:00
```

Configure System Settings:

Run the following to configure a network bridge:

bash

Copy code

```
sudo swapoff -a
echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a
/etc/sysctl.conf
sudo sysctl -p
```

```
[root@ip-172-31-22-81 ec2-user]# sudo swapoff -a
echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf
sudo sysctl -p
net.bridge.bridge-nf-call-iptables=1
net.bridge.bridge-nf-call-iptables = 1
[root@ip-172-31-22-81 ec2-user]#
```

i-0d3f7911e0aabcc35 (Master)

PublicIPs: 54.242.215.34 PrivateIPs: 172.31.22.81

PERFORM THE FOLLOWING ON ONLY THE MASTER MACHINE

Initialize Kubernetes:
Initialize your Kubernetes cluster with the following command:

bash
Copy code

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

```
[root@ip-172-31-22-81 ec2-user]# sudo kubeadm init --pod-network-cidr=10.244.0.0/16
--ignore-preflight-errors=all
I0915 07:56:11.461747   30220 version.go:256] remote version is much newer: v1.31.0; falling back to: stable-1.30
[init] Using Kubernetes version: v1.30.4
[preflight] Running pre-flight checks
        [WARNING FileExisting-socat]: socat not found in system path
        [WARNING FileExisting-tc]: tc not found in system path
        [WARNING Service-Kubelet]: kubelet service is not enabled, please run 'systemctl enable kubelet.service'
[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 in beforehand using 'kubeadm config images pull'
W0915 07:56:11.697643   30220 checks.go:844] detected that the sandbox image "registry.k8s.io/pause:3.8" of the contai
mended to use "registry.k8s.io/pause:3.9" as the CRI sandbox image.
[certs] Using certificateDir folder "/etc/kubernetes/pki"
[certs] Generating "ca" certificate and key
[certs] Generating "apiserver" certificate and key
[certs] apiserver serving cert is signed for DNS names [ip-172-31-22-81.ec2.internal kubernetes kubernetes.default kub
 [10.96.0.1 172.31.22.81]
[certs] Generating "apiserver-kubelet-client" certificate and key
[certs] Generating "front-proxy-ca" certificate and key
[certs] Generating "front-proxy-client" certificate and key
[certs] Generating "etcd/ca" certificate and key
[certs] Generating "etcd/server" certificate and key
[certs] etcd/server serving cert is signed for DNS names [ip-172-31-22-81.ec2.internal localhost] and IPs [172.31.22.8
[certs] Generating "etcd/peer" certificate and key
[certs] etcd/peer serving cert is signed for DNS names [ip-172-31-22-81.ec2.internal localhost] and IPs [172.31.22.81
[certs] Generating "etcd/healthcheck-client" certificate and key
```

Configure `kubectl` Access:

To set up `kubectl` for your non-root user, run:

bash
Copy code

```
mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

```
[root@ip-172-31-22-81 ec2-user]# mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
[root@ip-172-31-22-81 ec2-user]#
```

To check whether nodes are connected, run the command

- kubectl get nodes

This output shows only master is connected right now.

Kubtectl get nodes

```
[root@ip-172-31-22-81 ec2-user]# kubectl get nodes
NAME                           STATUS     ROLES           AGE     VERSION
ip-172-31-22-81.ec2.internal   NotReady   control-plane   4m52s   v1.30.5
```

Perform this Only on node Machines

```
[root@ip-172-31-22-81 ec2-user]# sudo yum install socat -y
Last metadata expiration check: 0:19:33 ago on Sun Sep 15 07:47:07 2024.
Dependencies resolved.
================================================================================
 Package          Architecture        Version                  Repository    Si
================================================================================
Installing:
 socat            x86_64              1.7.4.2-1.amzn2023.0.2   amazonlinux   303

Transaction Summary
================================================================================
Install  1 Package

Total download size: 303 k
Installed size: 1.1 M
Downloading Packages:
socat-1.7.4.2-1.amzn2023.0.2.x86_64.rpm          2.4 MB/s | 303 kB     00:00
--------------------------------------------------------------------------------
```

This is the token which we got
172.31.22.81:6443 --token 9wf1pg.1xgp88wof0wpslc9 \
--discovery-token-ca-cert-hash
sha256:b4efc86172e4999d3d1e530147cc26705f6543cd48689416874811c98b2a325f

Put this command on the node machine to connect

Now go Back to the master machine and write ‘kubectl get nodes’

```
[root@ip-172-31-22-81 docker]# kubectl get nodes
NAME                          STATUS     ROLES           AGE     VERSION
ip-172-31-22-81.ec2.internal  Ready      control-plane   4m13s   v1.30.5
ip-172-31-28-157.ec2.internal Not Ready  computer 1      2m24s   v1.30.5
ip-172-31-23-208.ec2.internal Not Ready  computer 2      2m17s   v1.30.5
```

We will see nodes are <NOT READY> to change it install a CNI plugin on Master Machine
kubectl apply -f
https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

Now ‘Run kubectl get nodes’

```
[root@ip-172-31-22-81 docker]# kubectl get nodes
NAME                          STATUS   ROLES           AGE     VERSION
ip-172-31-22-81.ec2.internal  Ready    control-plane   9m33s   v1.30.5
ip-172-31-28-157.ec2.internal Ready    computer 1      7m24s   v1.30.5
ip-172-31-23-208.ec2.internal Ready    computer 2      7m17s   v1.30.5
```

Conclusion

In this experiment, we explored the architecture of a Kubernetes cluster and successfully deployed it on AWS EC2 instances, consisting of a master node and two worker nodes. After setting up Docker, Kubernetes components (kubelet, kubeadm, kubectl), and containerd across all nodes, the cluster was initialized by configuring the master node and joining the worker nodes. Initially, the nodes showed a "NotReady" status, which was corrected by implementing the Calico networking solution. Additionally, nodes were labeled appropriately based on their roles. By the end of the process, all nodes were fully operational, confirming that the Kubernetes cluster was configured correctly .