Name-Ishan Kiran Joshi Div-D15C Roll No-21 A.Y.-2024-25

Experiment 3

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. Enter 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
- 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

Necessary Requirements:

● **EC2 Instance:** The experiment required launching a t2.medium EC2 instance with 2 CPUs, as Kubernetes demands sufficient resources for effective functioning.

● **Minimum Requirements:**

  - **Instance Type:** t2.medium
  - **CPUs:** 2
  - **Memory:** Adequate for container orchestration.

This ensured that the Kubernetes cluster had the necessary resources to function smoothly

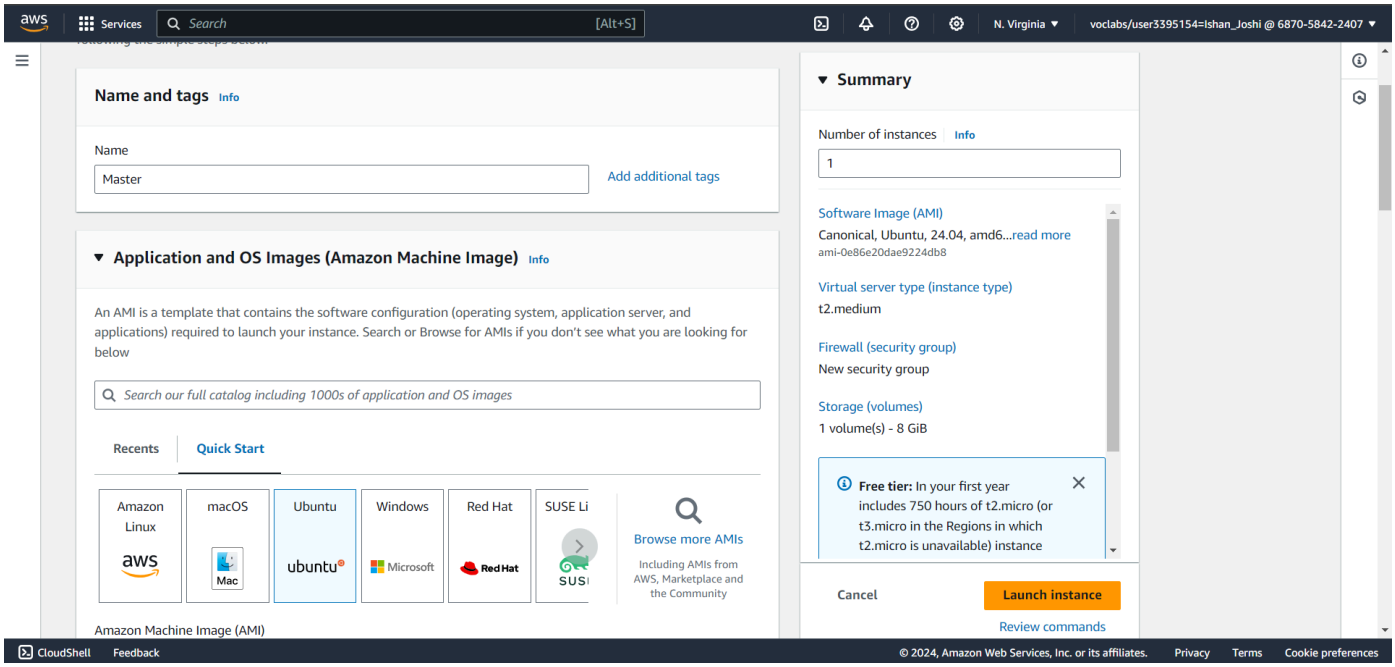
Create 2 Security Groups for Master and Nodes and add the following rules inbound rules in those Groups.

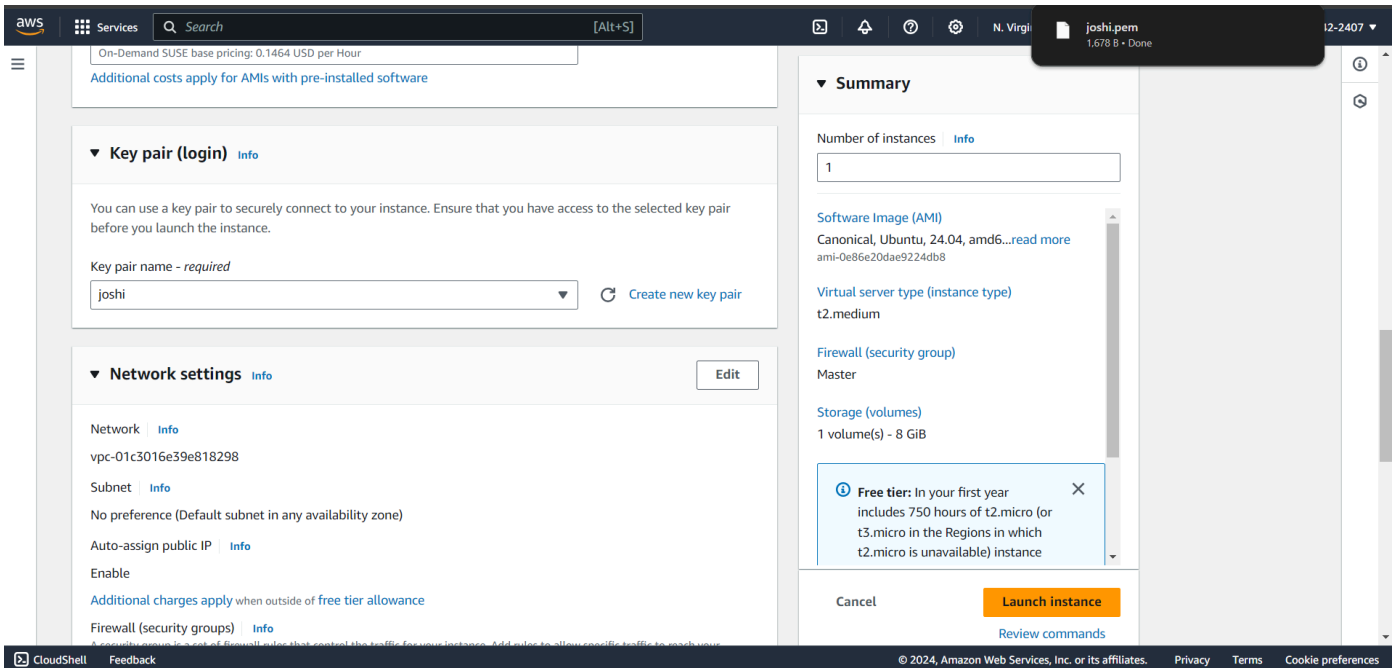
Master:

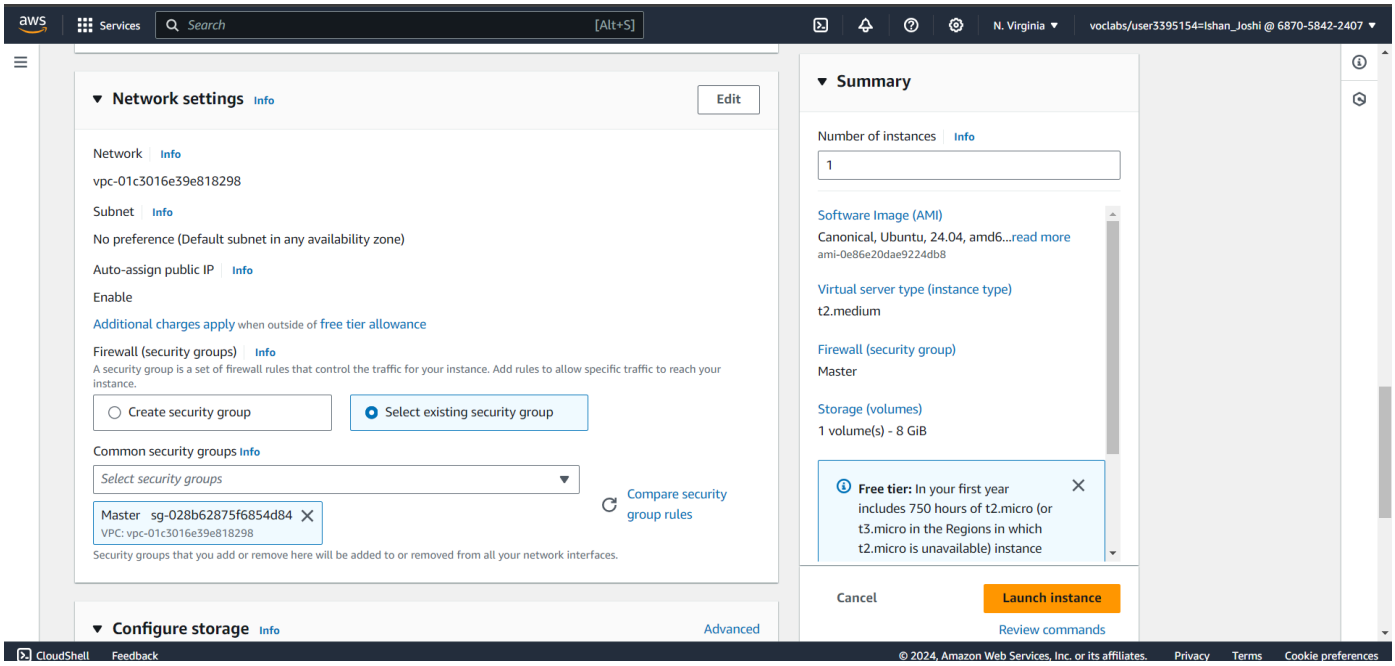
Node :

Step 1: Log in to your AWS Academy/personal account and launch 3 new Ec2 Instances. Select Ubuntu as AMI and t2.medium as Instance Type and create a key of type RSA with .pem extension and move the downloaded key to the new folder.We can use 3 Different keys or 1 common key also. Note: A minimum of 2 CPUs are required so Please select t2.medium and do not forget to stop the instance after the experiment because it is not available in the free tier.
Also Select Security groups from existing.

Master:

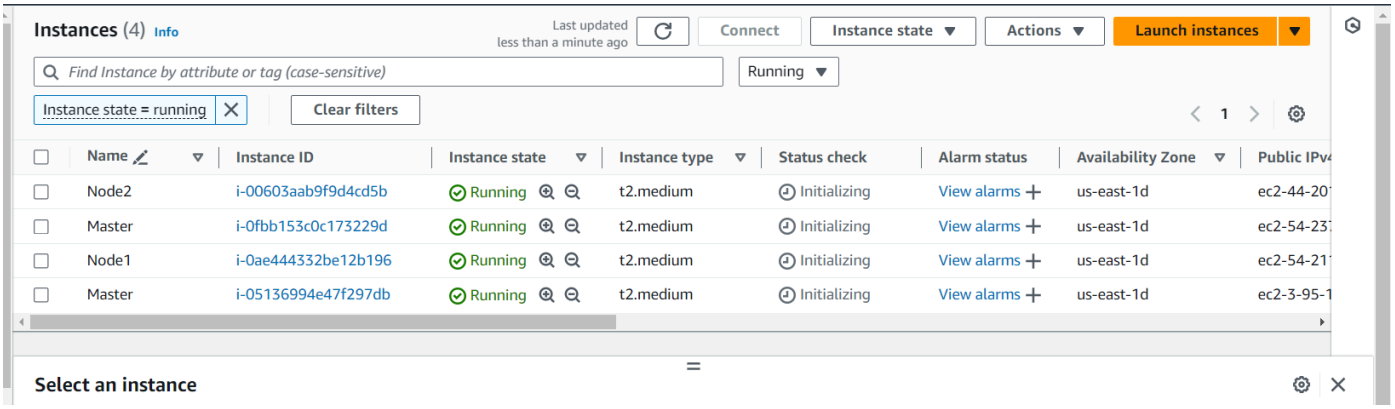




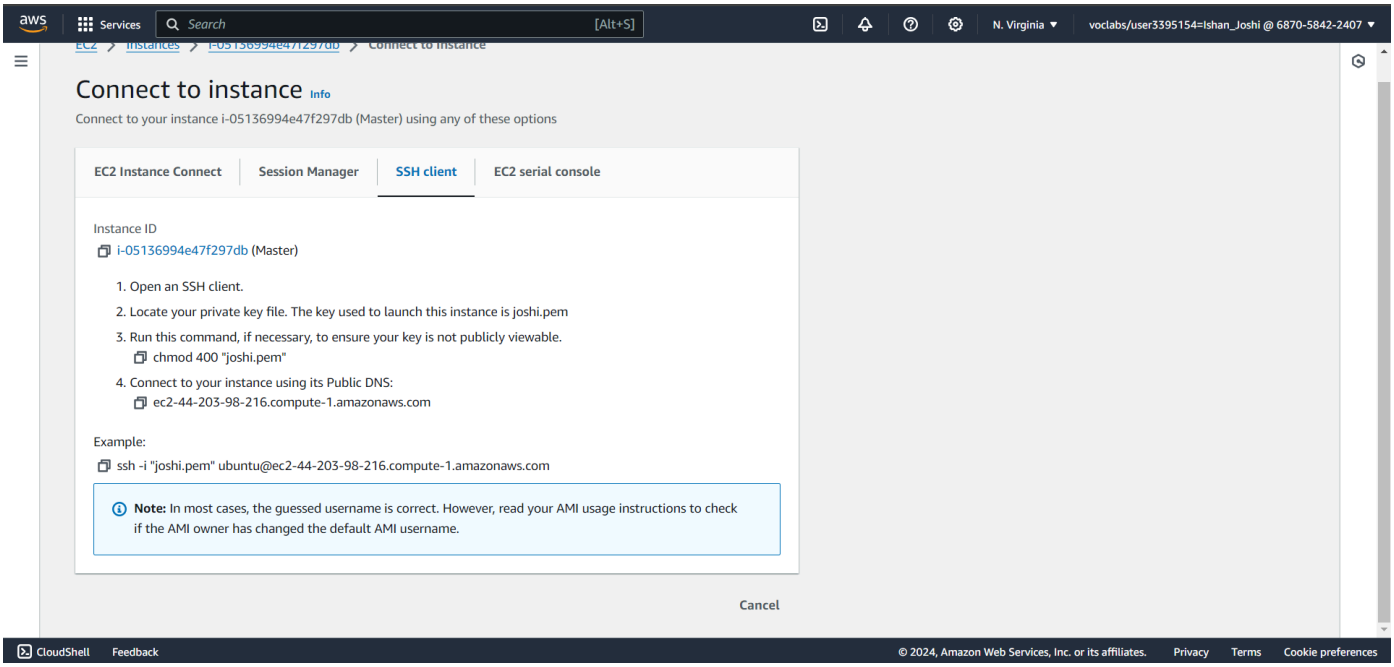


Do Same for 2 Nodes and use security groups of Node for that.

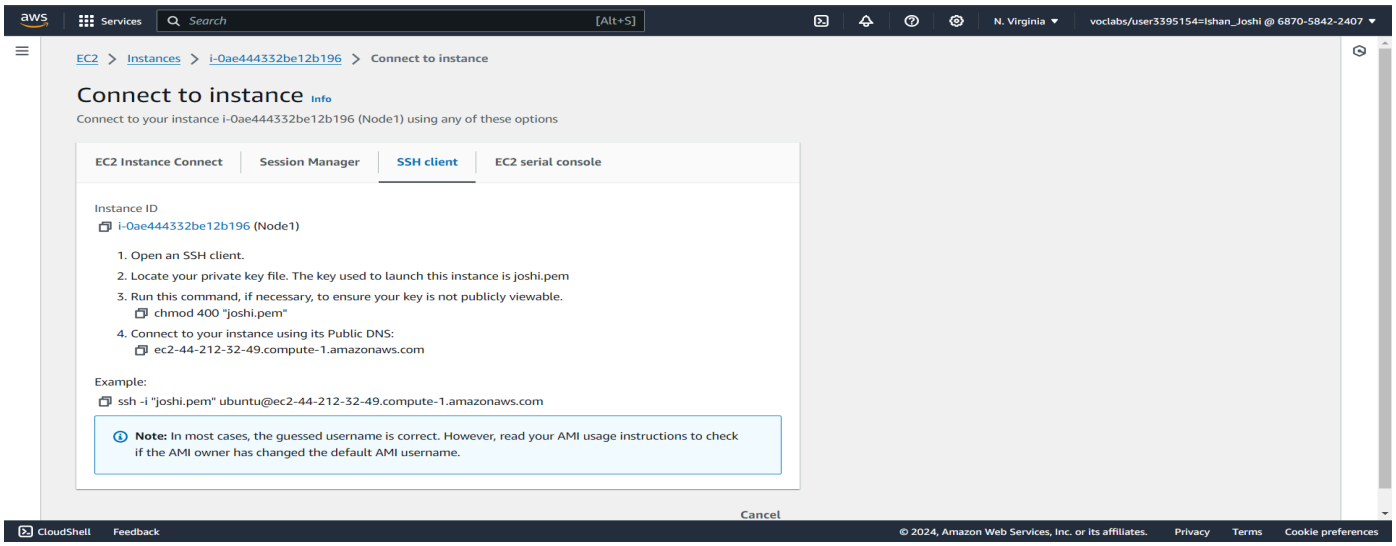
Step 2: After creating the instances click on Connect & connect all 3 instances and navigate to SSH Client.



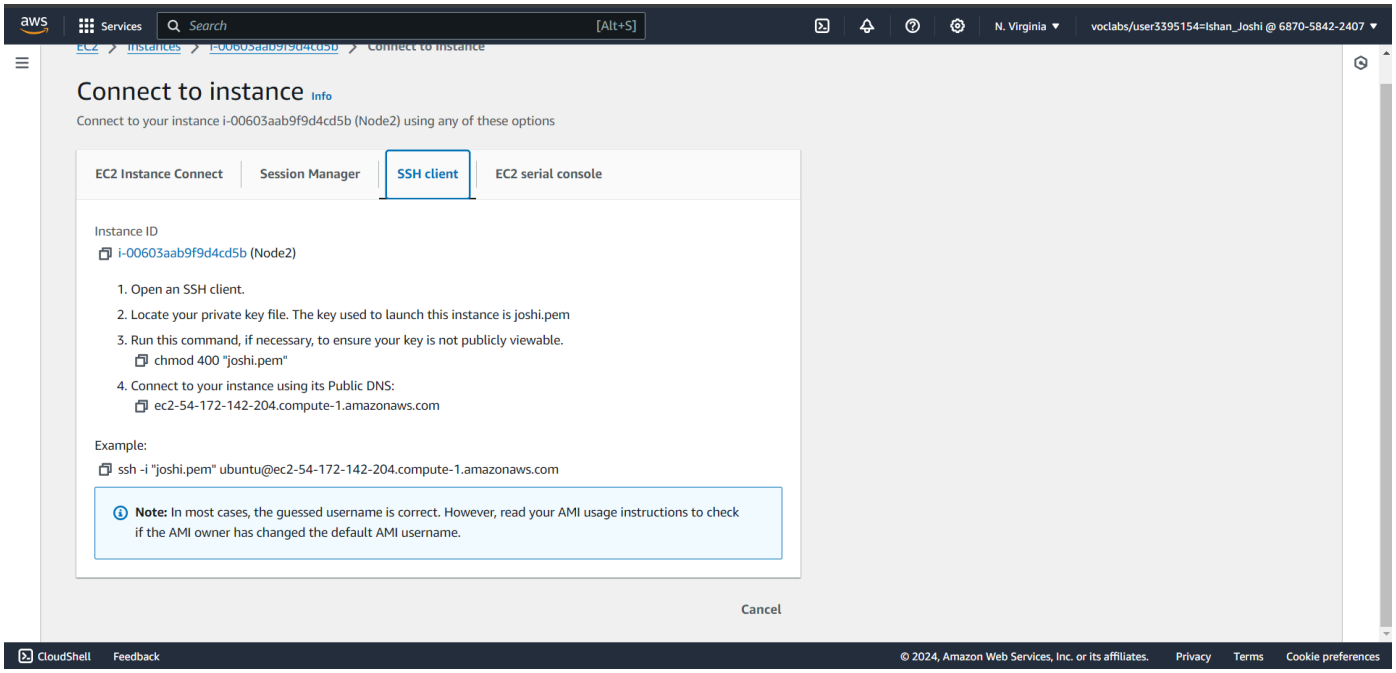
Step 3: Now open the folder in the terminal 3 times for Master, Node1& Node 2 where our .pem key is stored and paste the Example command (starting with ssh -i …..) in the terminal.(ssh -i "Master_Ec2_Key.pem" ubuntu@ec2-54-196-129-215.compute-1.amazonaws.com) Master:



Node 1:



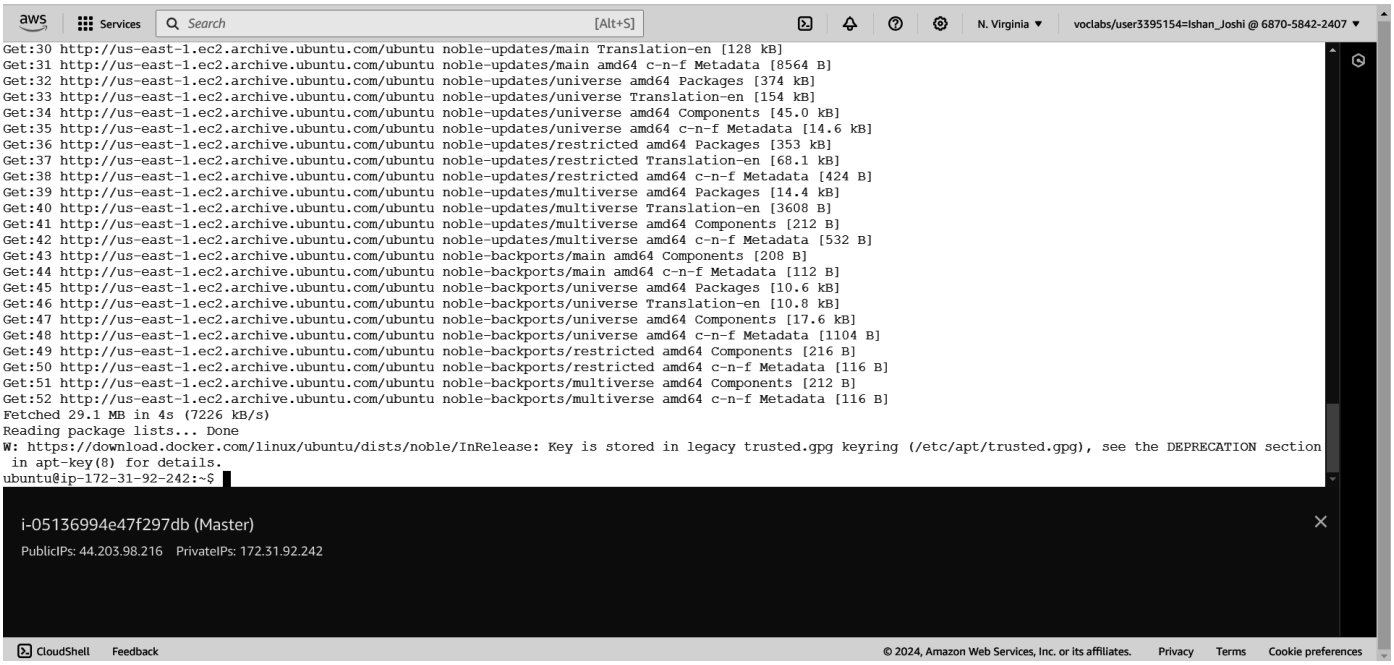
Node 2:



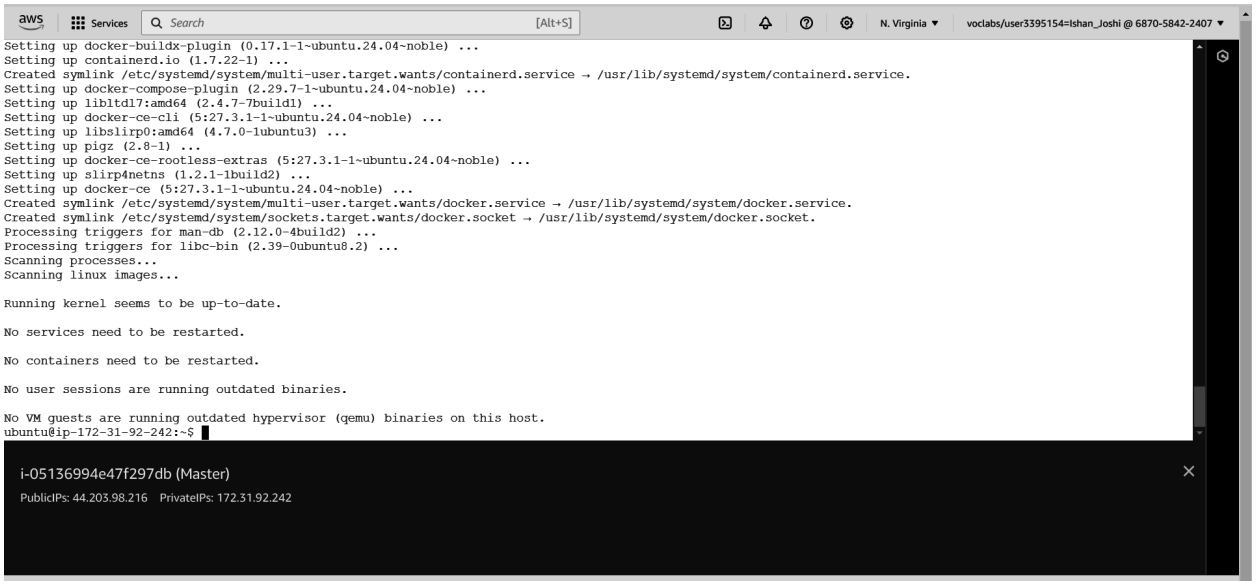
Step 4: Run on Master,Node 1,and Node 2 the below commands to install and setup Docker in Master, Node1, and Node2.

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

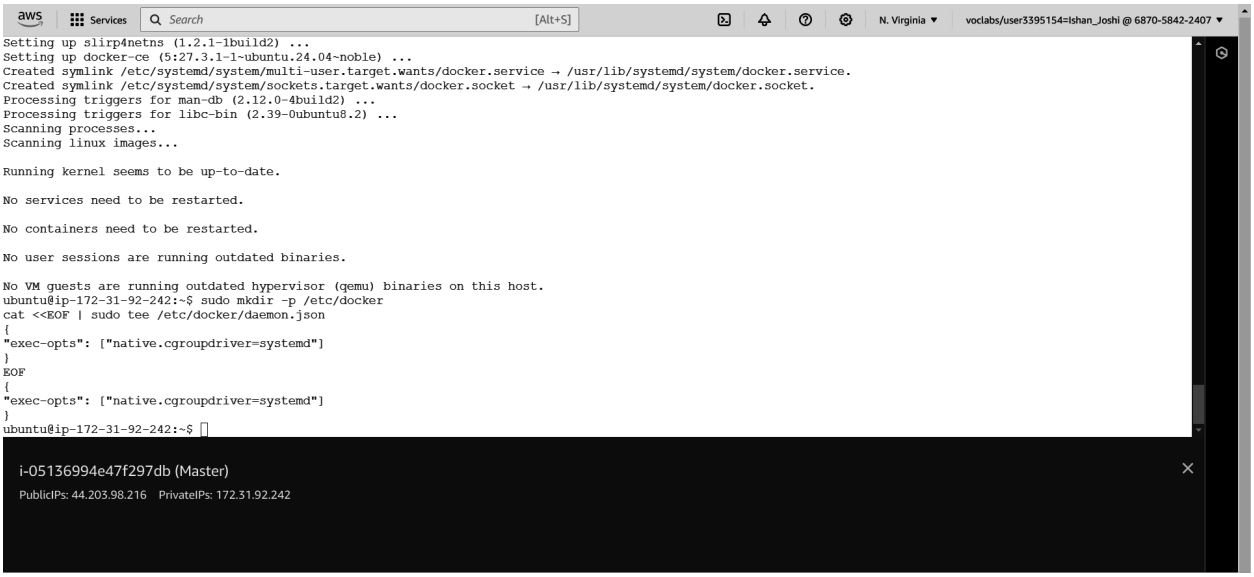
sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"



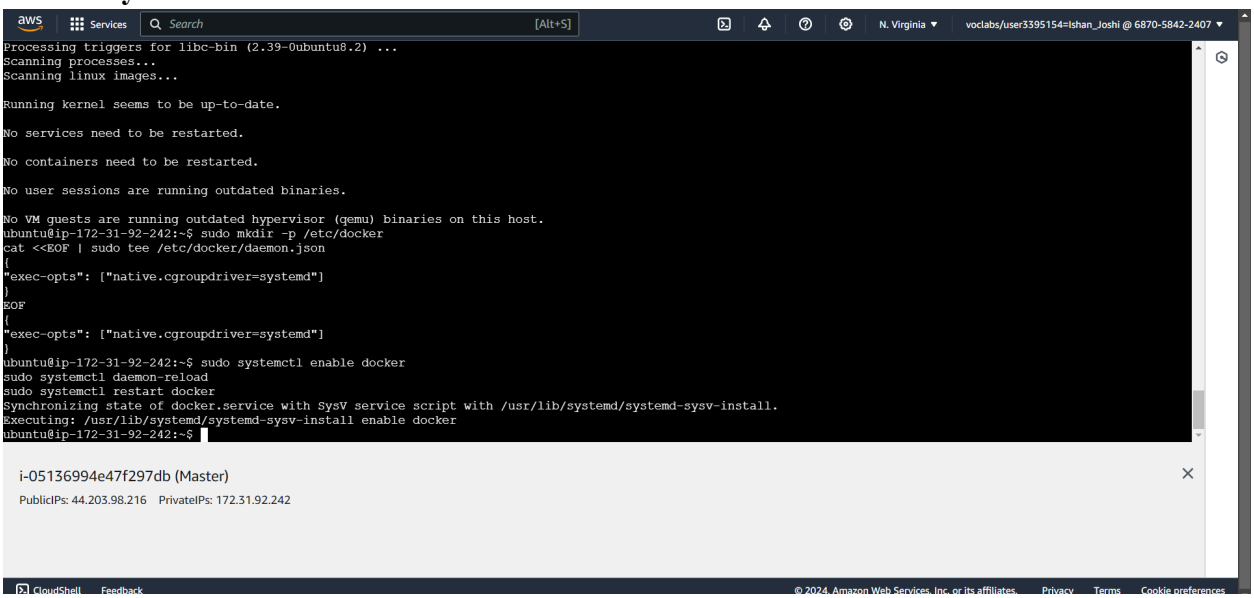
sudo apt-get update
sudo apt-get install -y docker-ce



sudo mkdir -p /etc/docker
cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
EOF

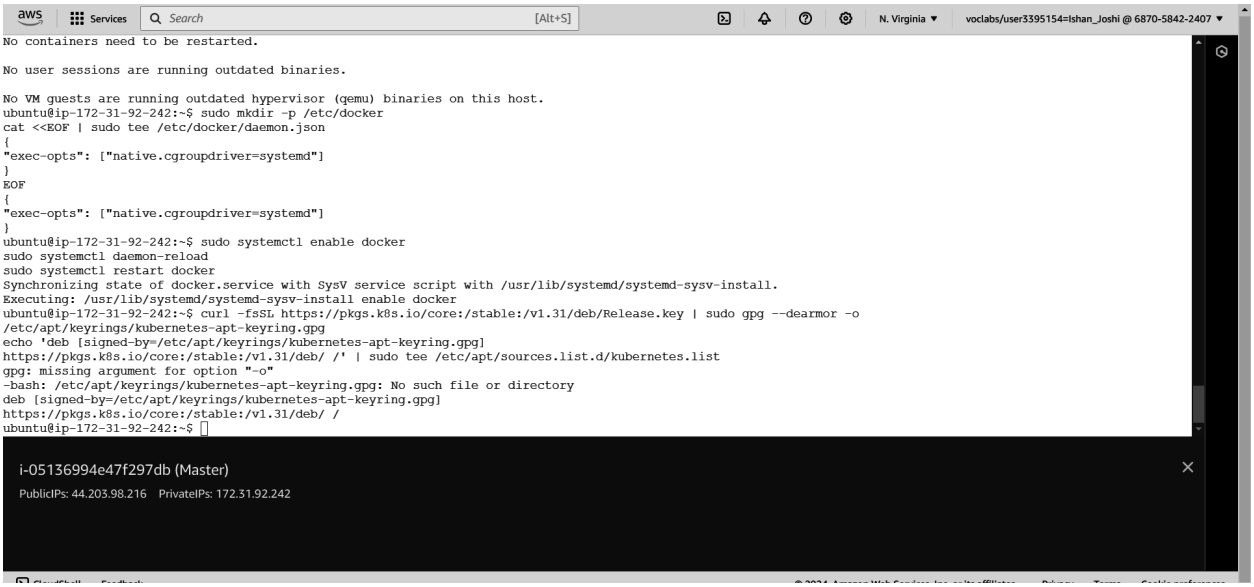


sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker

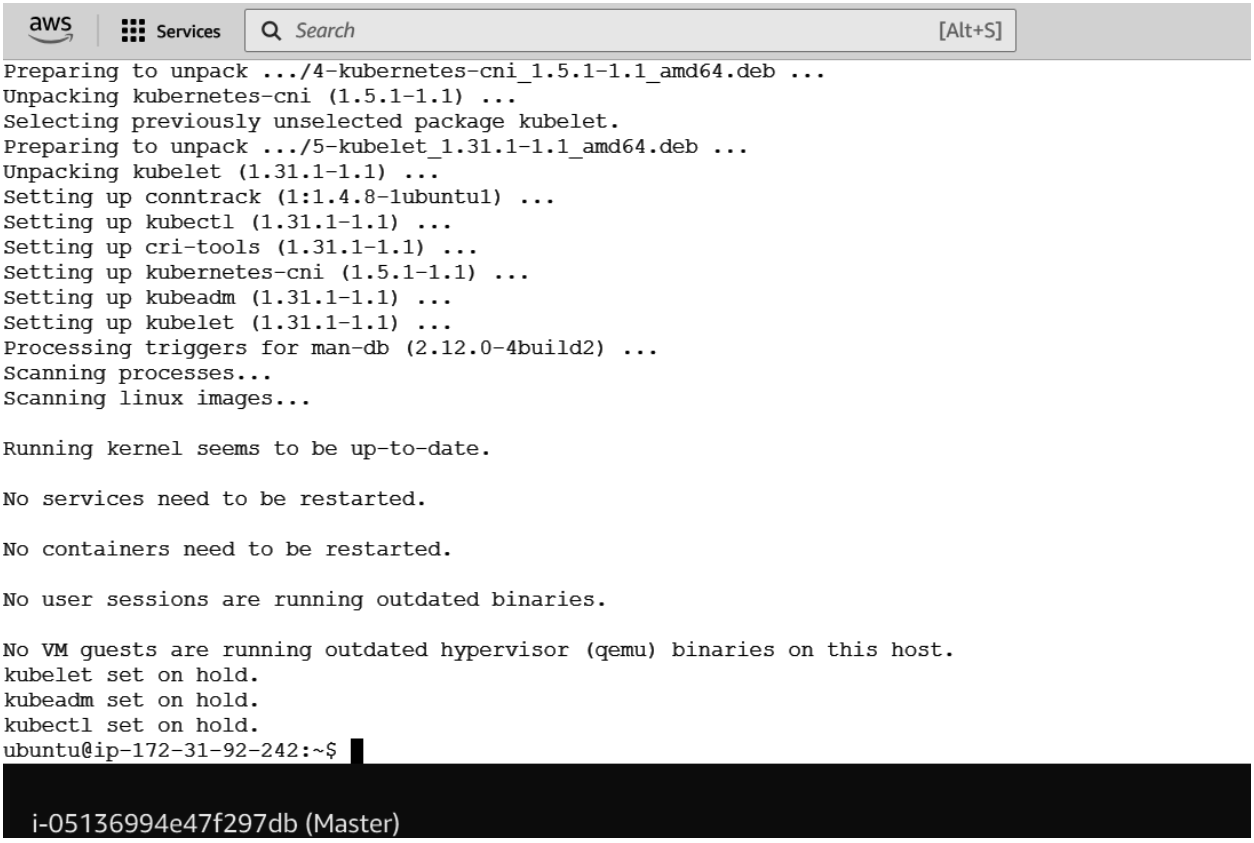


Step 5: Run the below command to install Kubernets.
curl -fsSL https://pkgs.k8s.io/core:/stable:/v1.31/deb/Release.key | sudo gpg --dearmor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg

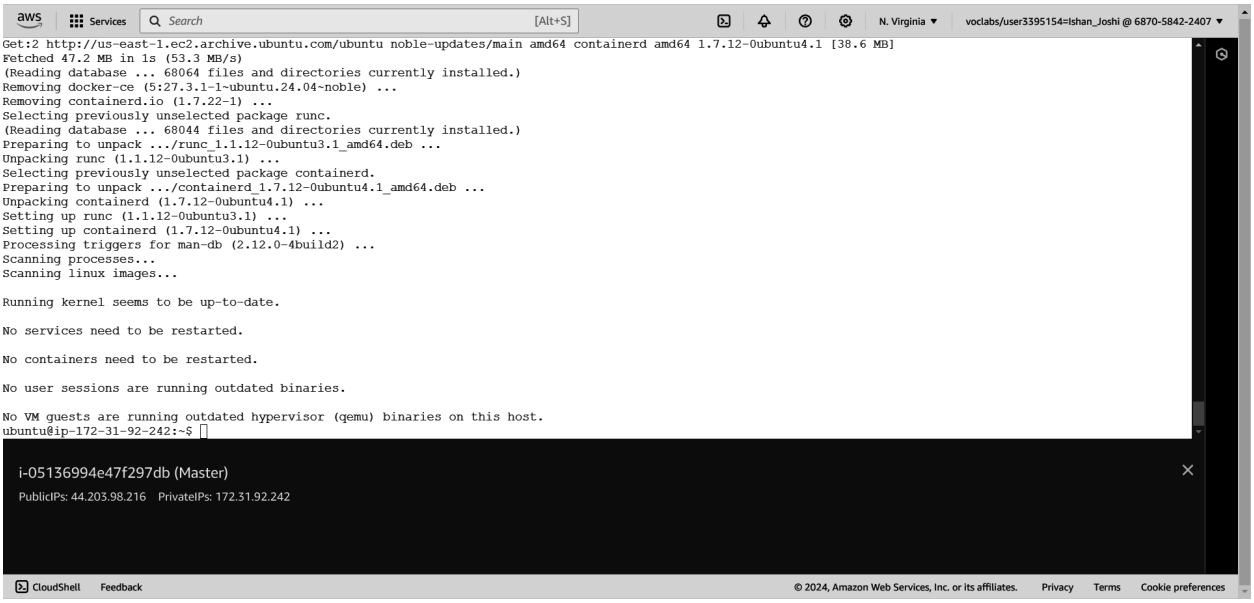
echo 'deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /' | sudo tee /etc/apt/sources.list.d/kubernetes.list



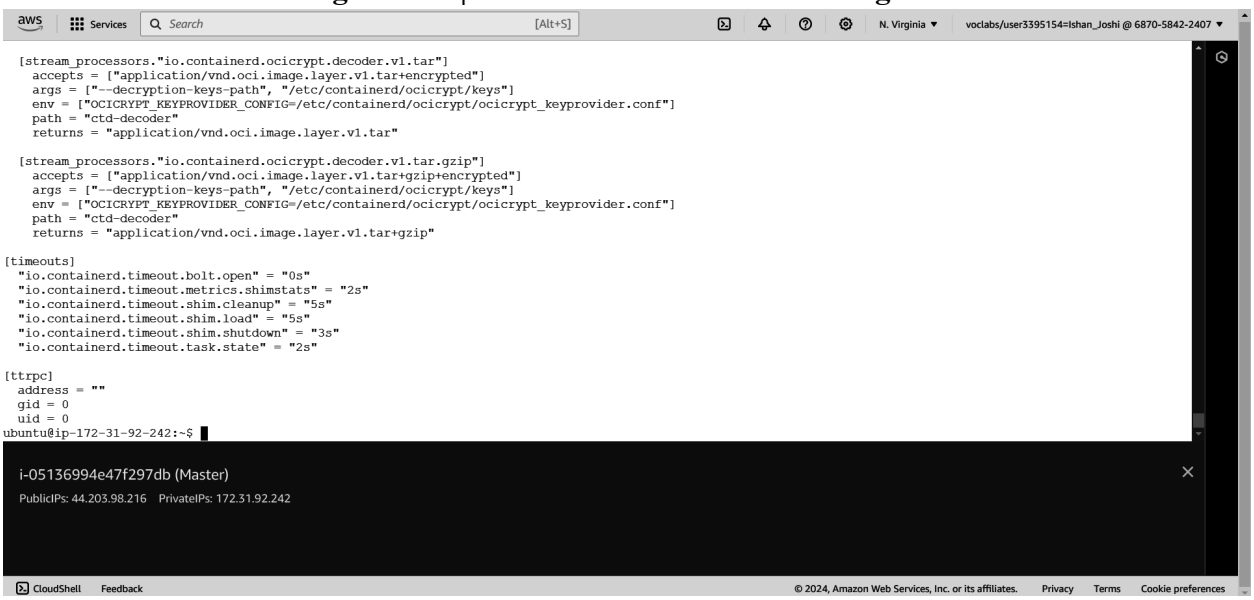
sudo apt-get update
sudo apt-get install -y kubelet kubeadm kubectl
sudo apt-mark hold kubelet kubeadm kubectl



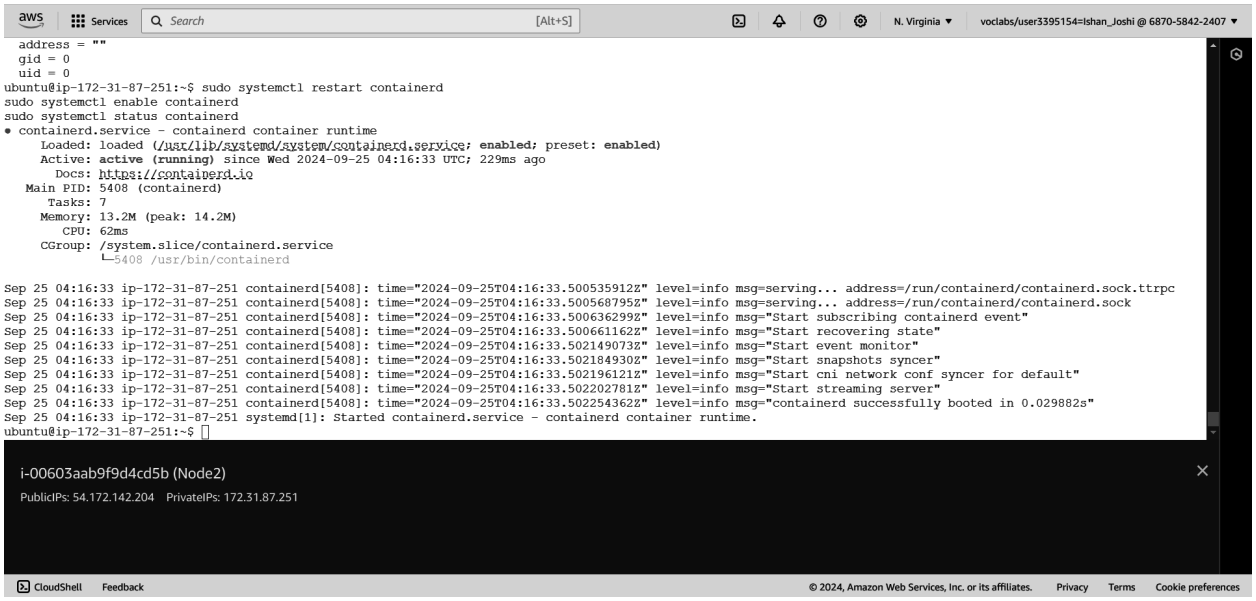
sudo systemctl enable --now kubelet
sudo apt-get install -y containerd



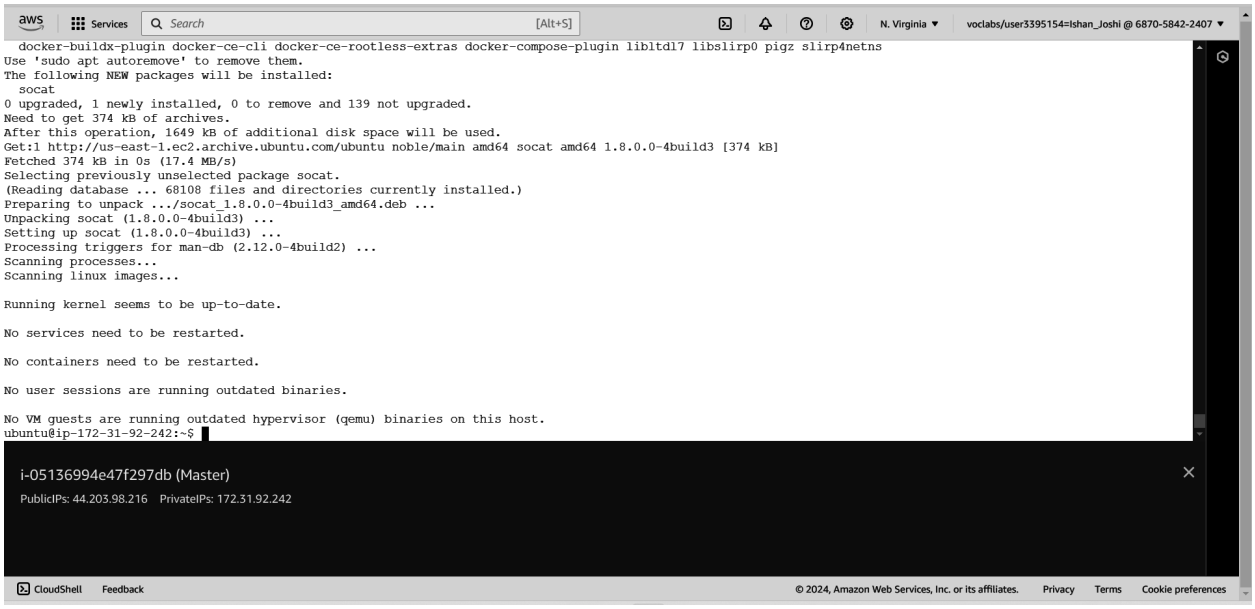
sudo mkdir -p /etc/containerd
sudo containerd config default | sudo tee /etc/containerd/config.toml



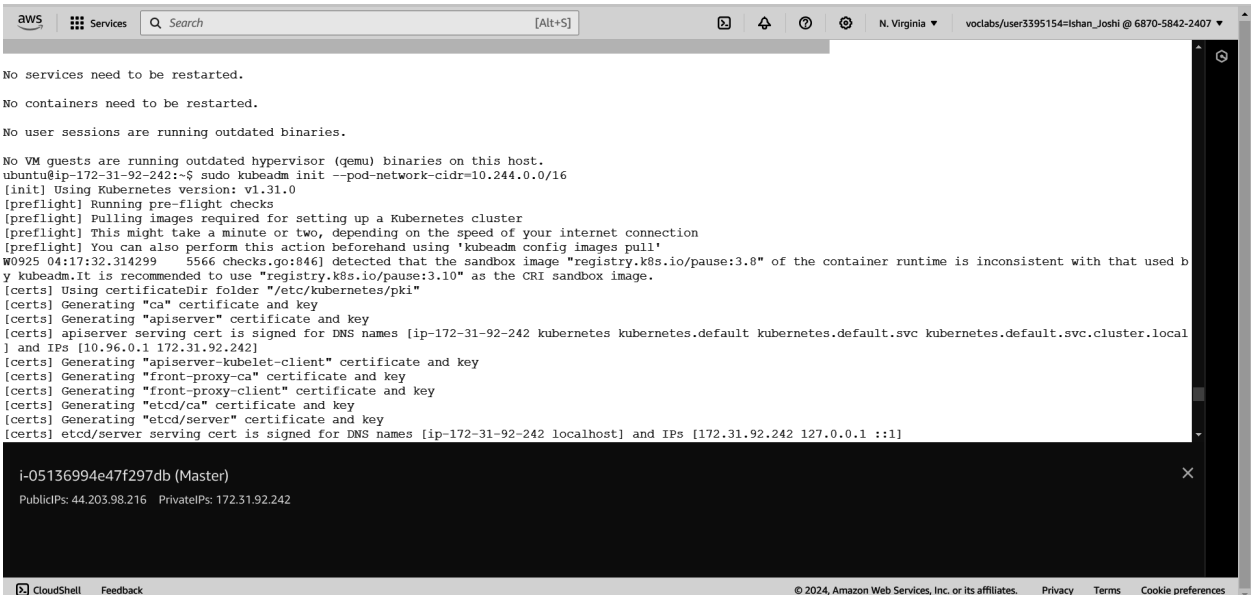
sudo systemctl restart containerd
sudo systemctl enable containerd
sudo systemctl status containerd

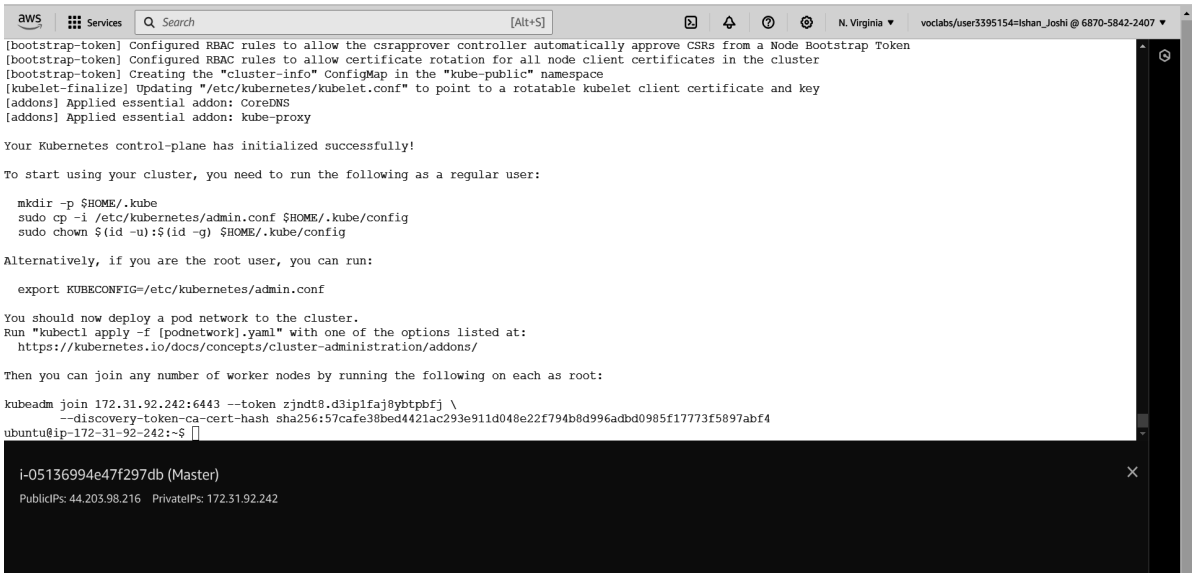


sudo apt-get install -y socat



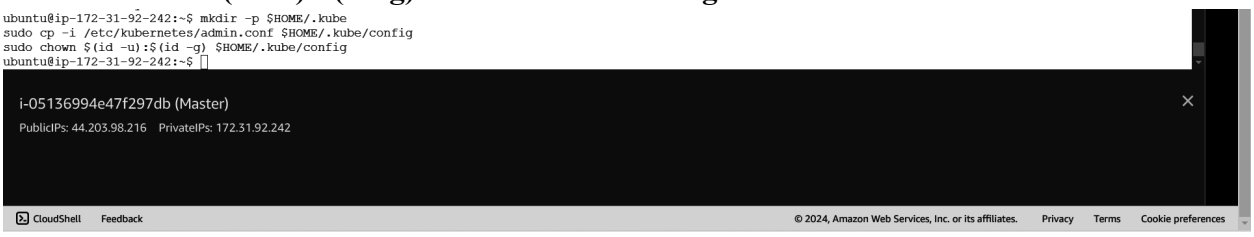
Step 6: Initialize the Kubecluster .Now Perform this Command only for Master. **sudo kubeadm init --pod-network-cidr=10.244.0.0/16**





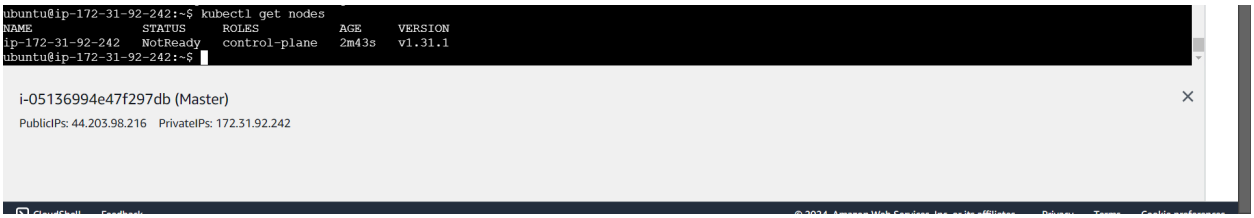
Run this command on master and also copy and save the Join command from above.

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



Step 7: Now Run the command kubectl get nodes to see the nodes before executing Join command

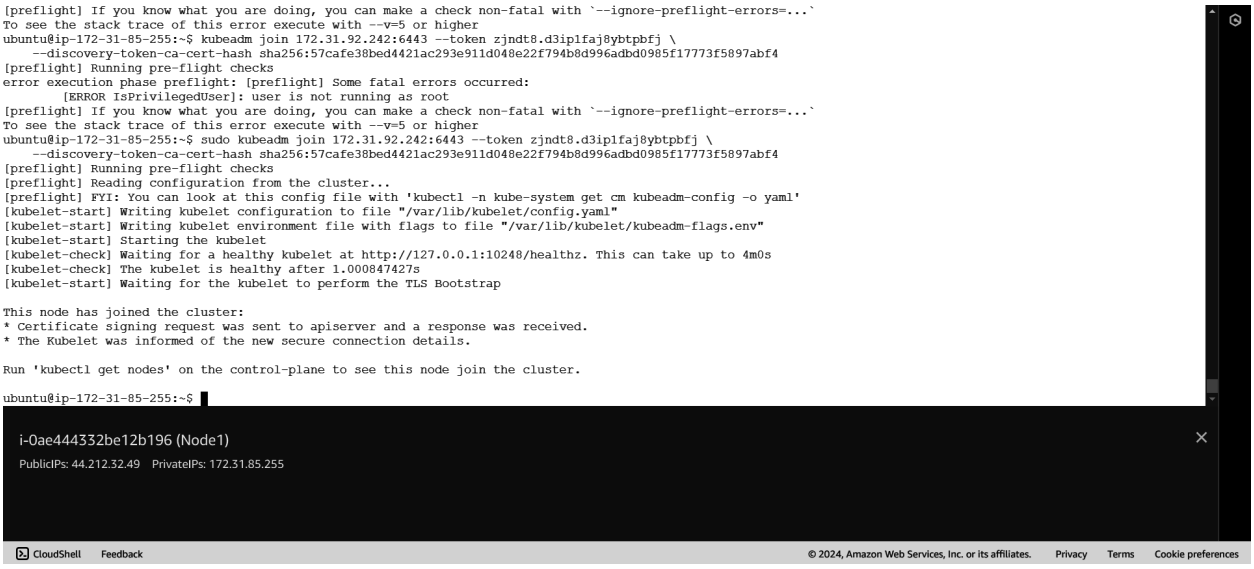
on nodes.



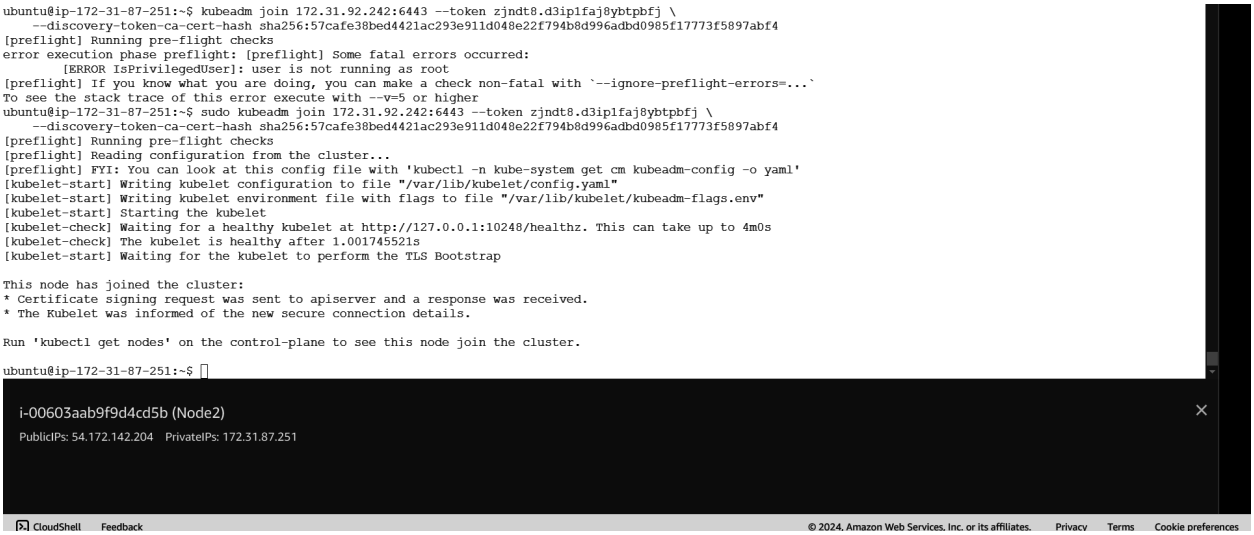
Step 8: Now Run the following command on Node 1 and Node 2 to Join to master.

**sudo kubeadm join 172.31.27.176:6443 --token ttay2x.n0sqeukjai8sgfg3 **
--discovery-token-ca-cert-hash
sha256:d6fc5fb7e984c83e2807780047fec6c4f2acfe9da9184ecc028d77157608fbb6

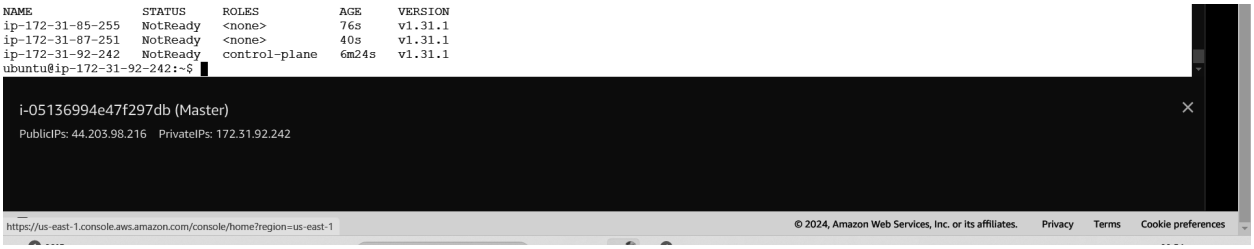
Node 1:



Node 2:

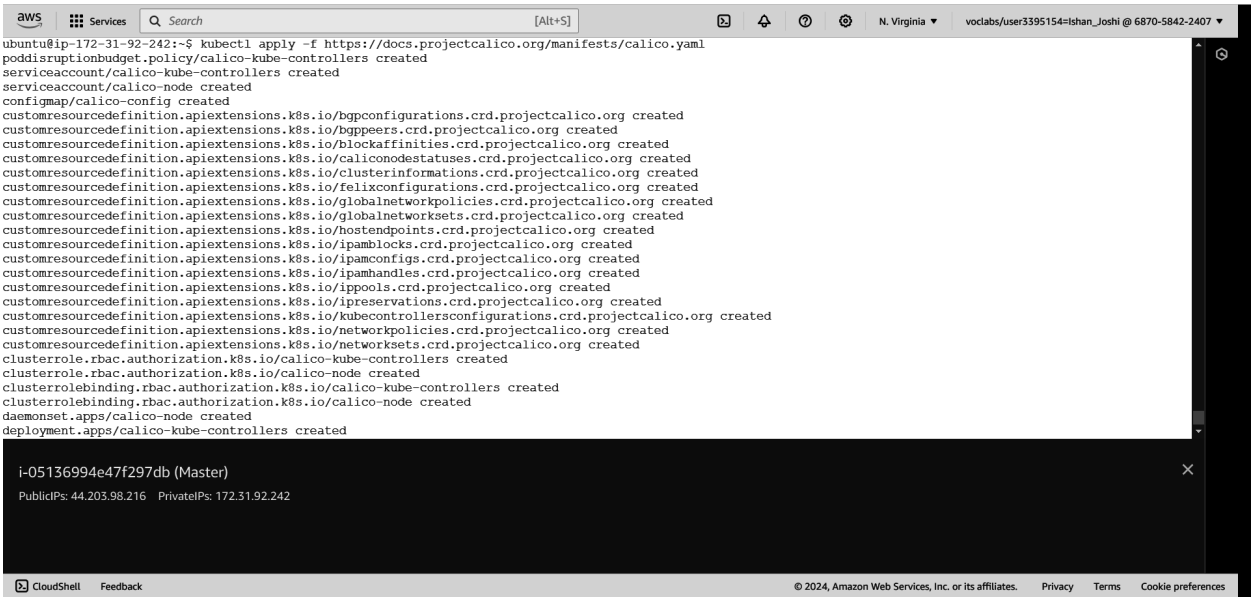


Step 9: Now Run the command kubectl get nodes to see the nodes after executing Join command on nodes.

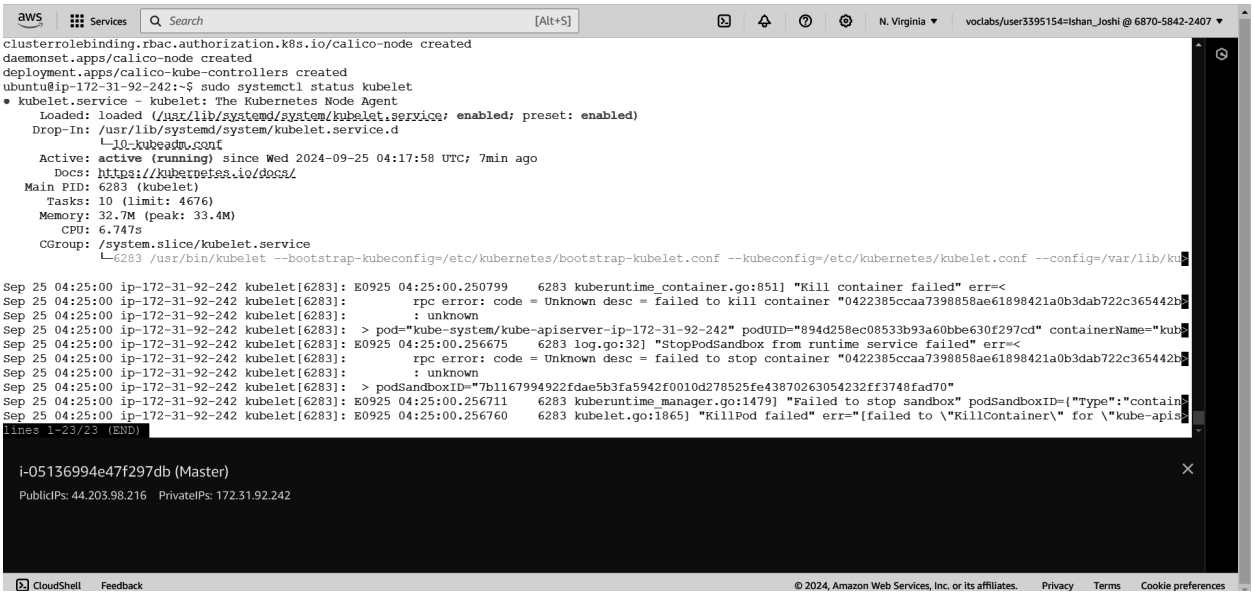


Step 10: Since Status is NotReady we have to add a network plugin. And also we have to give the name to the nodes.

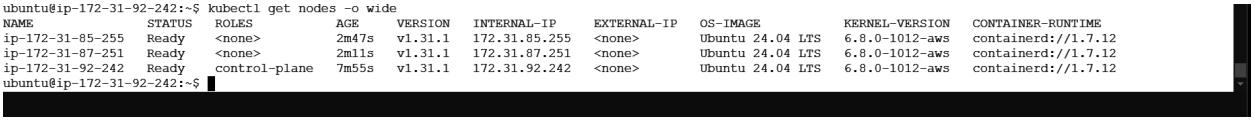
kubectl apply -f https://docs.projectcalico.org/manifests/calico.yaml



sudo systemctl status kubelet



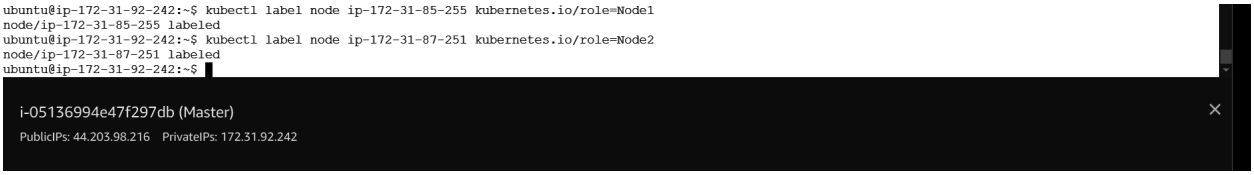
command kubectl get nodes -o wide we can see Status is ready.



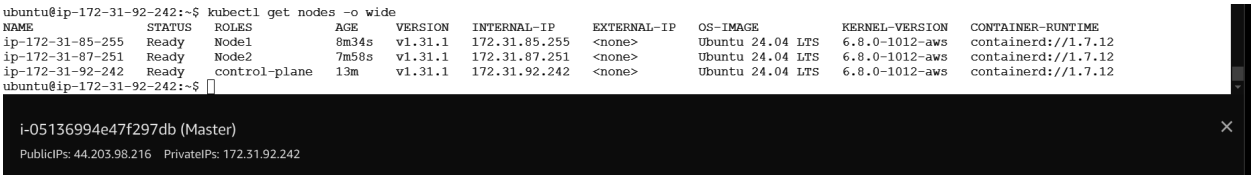
Now to Rename run this command

kubectl label node ip-172-31-18-135 kubernetes.io/role=worker

Rename to Node 1:kubectl label node ip-172-31-28-117 kubernetes.io/role=Node1
Rename to Node 2:kubectl label node ip-172-31-18-135 kubernetes.io/role=Node2



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.



Or run kubectl get nodes

Conclusion: In this experiment, we effectively established a Kubernetes cluster comprising a single master and two worker nodes using AWS EC2 instances. We began by installing Docker, Kubernetes components (kubelet, kubeadm, and kubectl), and containerd on each node. Following this, the master node was initialized, and the worker nodes were joined to the cluster. Although the nodes initially appeared in the NotReady state, installing the Calico network plugin resolved this issue. We also assigned appropriate labels to the nodes, designating their roles as control-plane and worker. Ultimately,

the cluster became fully operational with all nodes in the Ready state, confirming the successful setup and orchestration of Kubernetes.