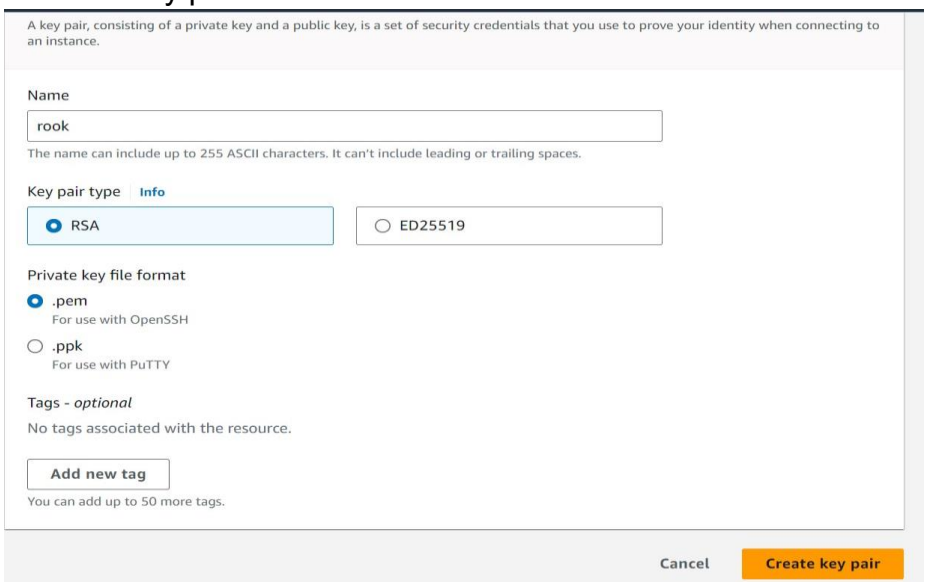
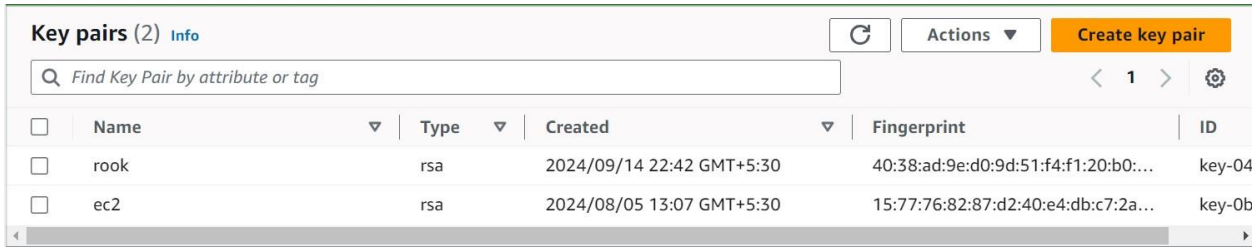
Aim:

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

Steps:

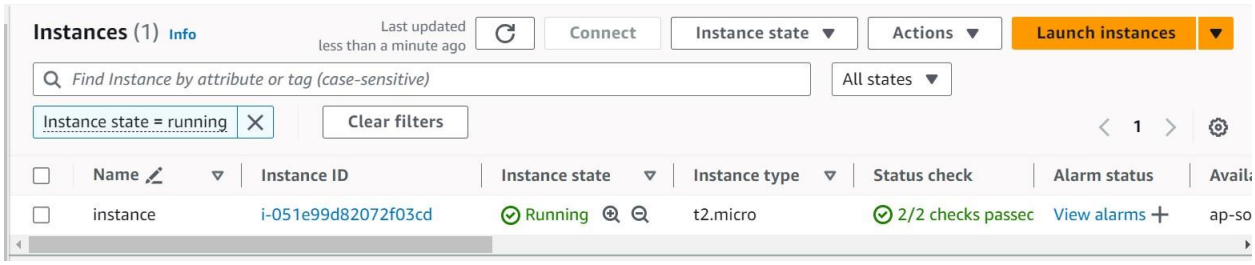
1. Create a key pair.



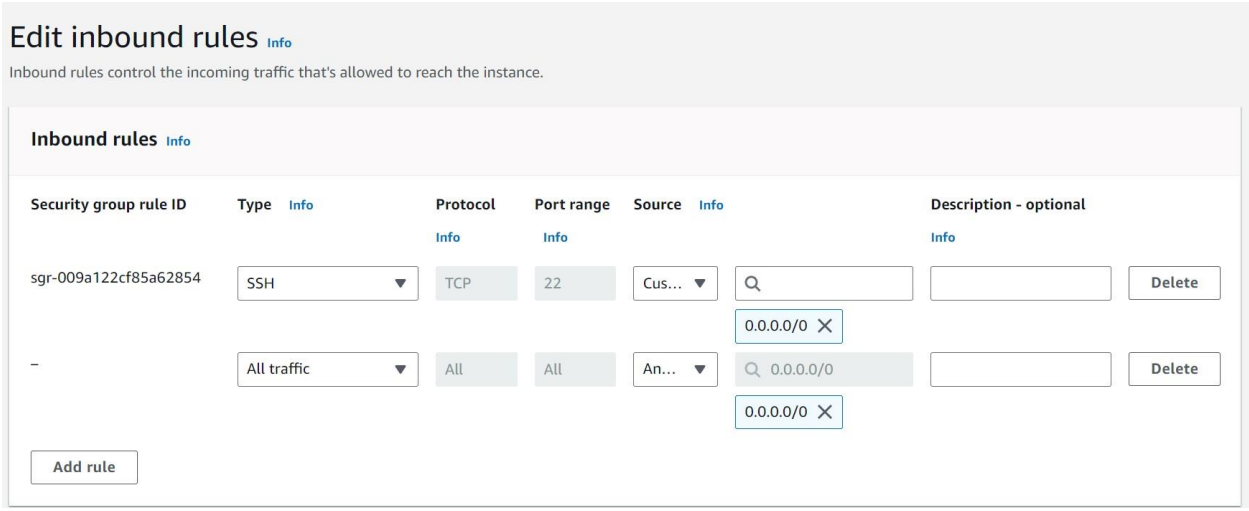


The .pem file will be downloaded on your machine and will be required in the further steps.

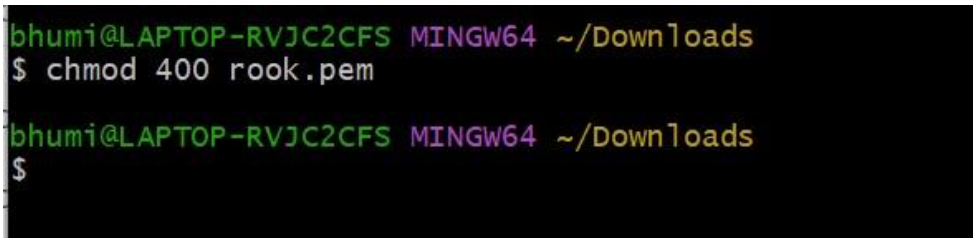
2. Now we will create an EC2 Ubuntu instance. Select the key pair which you just created while creating this instance.



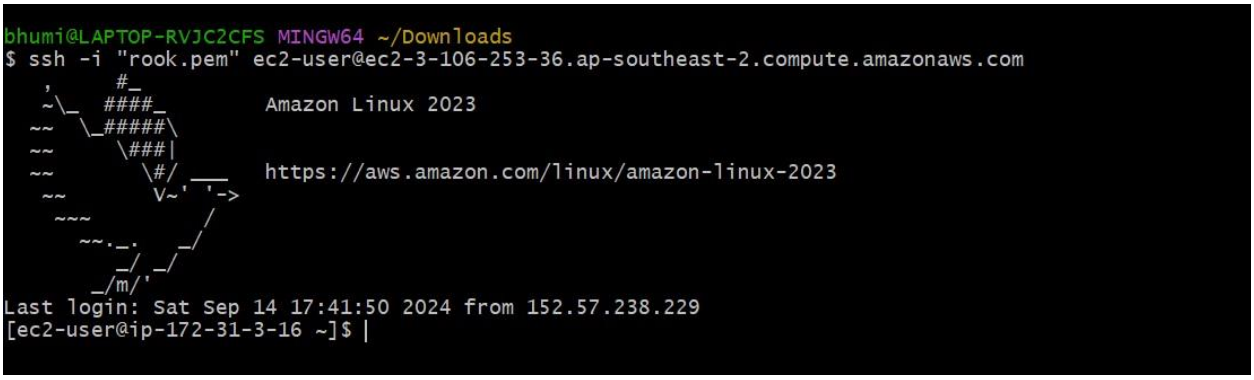
3. Now edit the inbound rules to allow ssh.



4. Open git bash and go to the directory where pem file is located and use chmod to provide permissions.

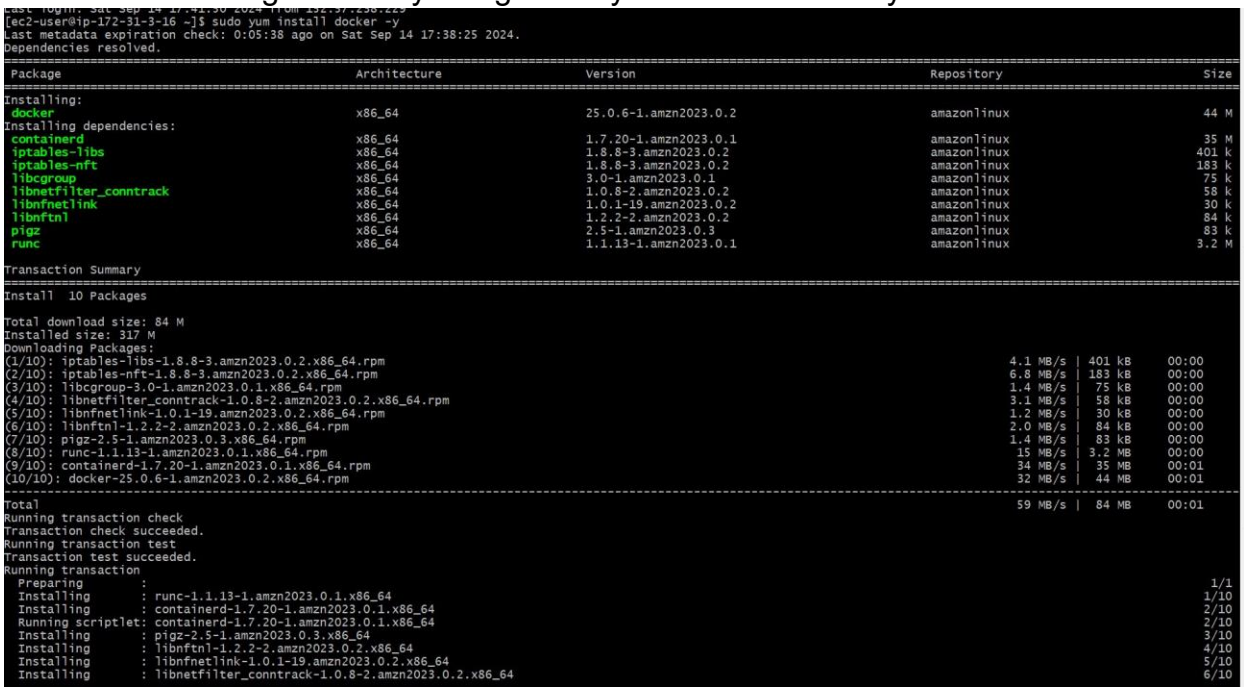


5. Now use this command on the terminal: ssh -i <keyname>.pem ubuntu@ and replace
   - Keyname with the name of your key pair, in our case test1.
   - As we are using amazon Linux instead of ubuntu we will have ec2-user • Replace public ip address with its value. Go to your instance and scroll down and you will find the public ip address there.



6. Docker installation:

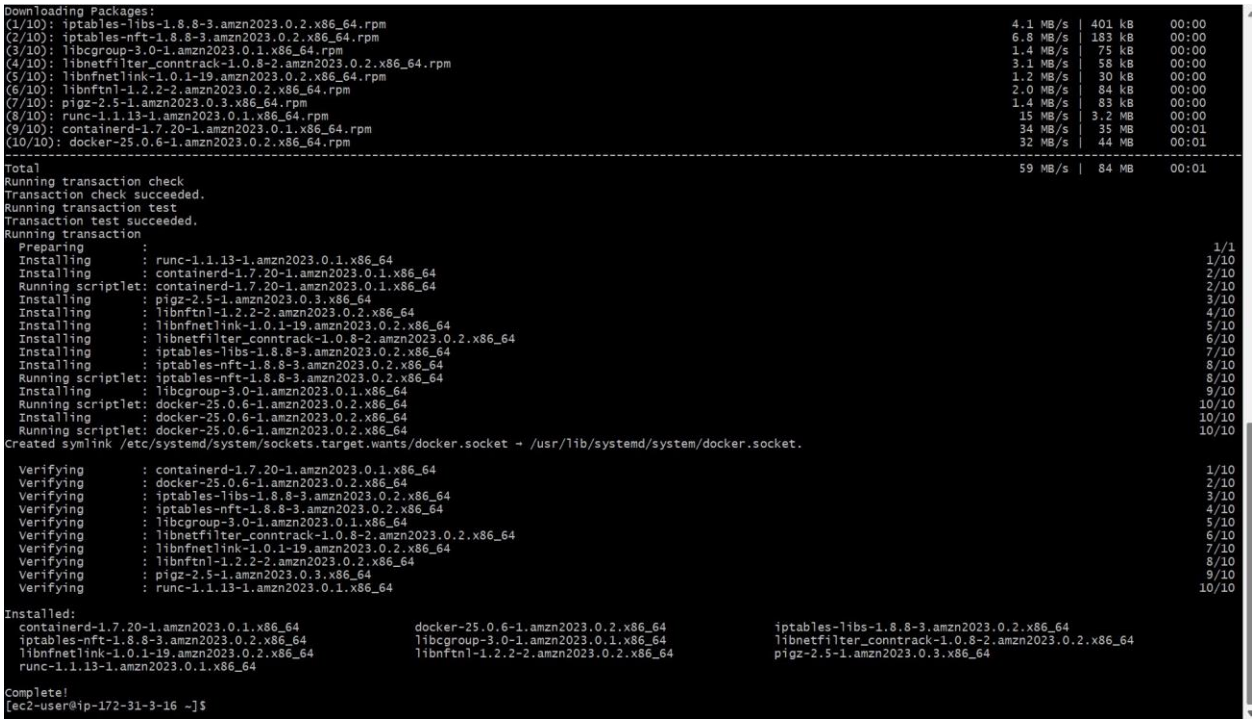
We will be installing docker by using “sudo yum install docker -y”



```
[ec2-user@ip-172-31-3-16 ~]$ sudo yum install docker -y
Last metadata expiration check: 0:05:38 ago on Sat Sep 14 17:38:25 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      4.1 MB/s | 401 kB  00:00
(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm       6.8 MB/s | 183 kB  00:00
(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm            1.4 MB/s |  75 kB  00:00
(4/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64 3.1 MB/s |  58 kB  00:00
(5/10): libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64.rpm      1.2 MB/s |  30 kB  00:00
(6/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm           2.0 MB/s |  84 kB  00:00
(7/10): pigz-2.5-1.amzn2023.0.3.x86_64.rpm                 1.4 MB/s |  83 kB  00:00
(8/10): runc-1.1.13-1.amzn2023.0.1.x86_64.rpm               15 MB/s | 3.2 MB  00:00
(9/10): containerd-1.7.20-1.amzn2023.0.1.x86_64.rpm         34 MB/s |  35 MB  00:01
(10/10): docker-25.0.6-1.amzn2023.0.2.x86_64.rpm            32 MB/s |  44 MB  00:01
--------------------------------------------------------------------------------
Total                                                       59 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
```



```
Downloading Packages:
(1/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm      4.1 MB/s | 401 kB  00:00
(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm       6.8 MB/s | 183 kB  00:00
(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm            1.4 MB/s |  75 kB  00:00
(4/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64 3.1 MB/s |  58 kB  00:00
(5/10): libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64.rpm      1.2 MB/s |  30 kB  00:00
(6/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm           2.0 MB/s |  84 kB  00:00
(7/10): pigz-2.5-1.amzn2023.0.3.x86_64.rpm                 1.4 MB/s |  83 kB  00:00
(8/10): runc-1.1.13-1.amzn2023.0.1.x86_64.rpm               15 MB/s | 3.2 MB  00:00
(9/10): containerd-1.7.20-1.amzn2023.0.1.x86_64.rpm         34 MB/s |  35 MB  00:01
(10/10): docker-25.0.6-1.amzn2023.0.2.x86_64.rpm            32 MB/s |  44 MB  00:01
--------------------------------------------------------------------------------
Total                                                       59 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.

  Verifying        : containerd-1.7.20-1.amzn2023.0.1.x86_64               1/10
  Verifying        : docker-25.0.6-1.amzn2023.0.2.x86_64                   2/10
  Verifying        : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64             3/10
  Verifying        : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64              4/10
  Verifying        : libcgroup-3.0-1.amzn2023.0.1.x86_64                   5/10
  Verifying        : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64    6/10
  Verifying        : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64             7/10
  Verifying        : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                  8/10
  Verifying        : pigz-2.5-1.amzn2023.0.3.x86_64                        9/10
  Verifying        : runc-1.1.13-1.amzn2023.0.1.x86_64                    10/10

Installed:
  containerd-1.7.20-1.amzn2023.0.1.x86_64  docker-25.0.6-1.amzn2023.0.2.x86_64  iptables-libs-1.8.8-3.amzn2023.0.2.x86_64
  iptables-nft-1.8.8-3.amzn2023.0.2.x86_64  libcgroup-3.0-1.amzn2023.0.1.x86_64  libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64
  libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64  libnftnl-1.2.2-2.amzn2023.0.2.x86_64  pigz-2.5-1.amzn2023.0.3.x86_64
  runc-1.1.13-1.amzn2023.0.1.x86_64

Complete!
[ec2-user@ip-172-31-3-16 ~]$
```

7. Then to configure cgroup in a daemon json file we will run cd /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

```
[ec2-user@ip-172-31-3-16 ~]$ cd /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
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/systemd/system/docker.service.
[ec2-user@ip-172-31-3-16 docker]$
```

8. Kubernetes installation:
   Search kubeadm installation on your browser and scroll down and select red hat-based distributions.

1. Set SELinux to `permissive` mode:

These instructions are for Kubernetes 1.31.

```
Linux in permissive mode (effectively disabling it)
enforce 0
 -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

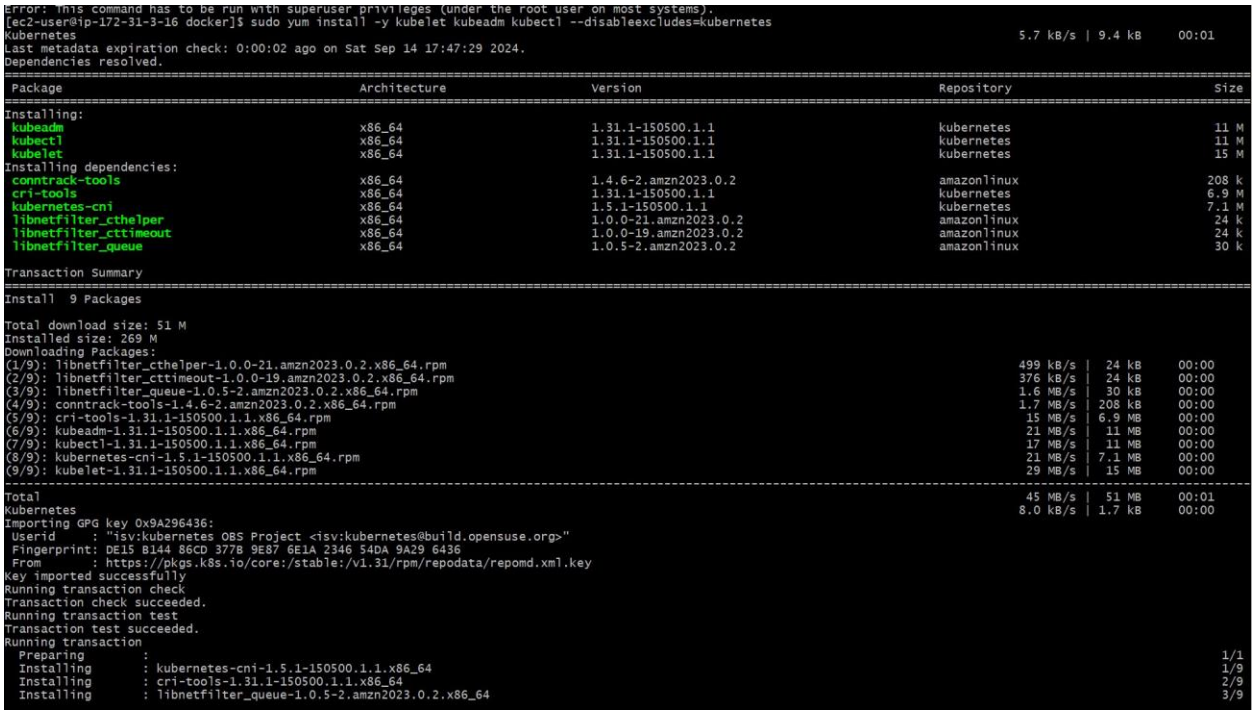
```
# This overwrites any existing configuration in /etc/yum.repos.d/
cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repom
exclude=kubelet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

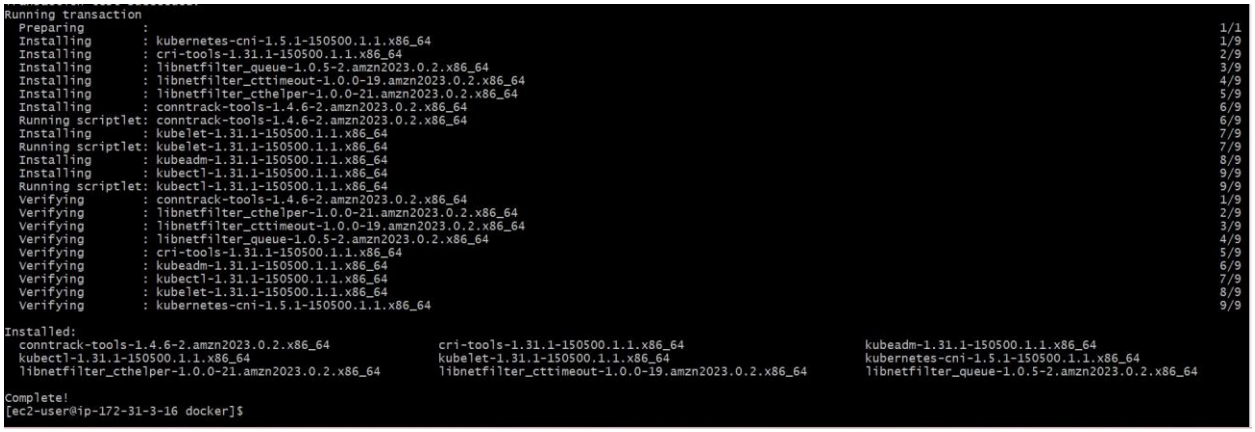
3. Install kubelet, kubeadm and kubectl:

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

4. (Optional) Enable the kubelet service before running kubeadm:

```
sudo systemctl enable --now kubelet
```





9. After installing Kubernetes, we need to configure internet options to allow bridging.

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

10. Initializing kubecluster:

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

```
Your Kubernetes control-plane has initialized successfully!

To start using your cluster, you need to run the following as a regular user:

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

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 172.31.3.16:6443 --token ekhyop.xkge2agz07jxxqqs \
        --discovery-token-ca-cert-hash sha256:8206263b4e2632eb03dafa4819c7c8505d47b21e8ba8c4901d5802c791c806f7
[ec2-user@ip-172-31-3-16 docker]$
```

11. The mkdir command that is generated after initialization has to be copy pasted in the terminal.

```
[ec2-user@ip-172-31-3-16 docker]$ mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config
[ec2-user@ip-172-31-3-16 docker]$
```

12. Then, add a common networking plugin called flannel:
    kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/ kube-flannel.yml

```
[ec2-user@ip-172-31-3-16 docker]$ kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml
namespace/kube-flannel created
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
serviceaccount/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
[ec2-user@ip-172-31-3-16 docker]$
```

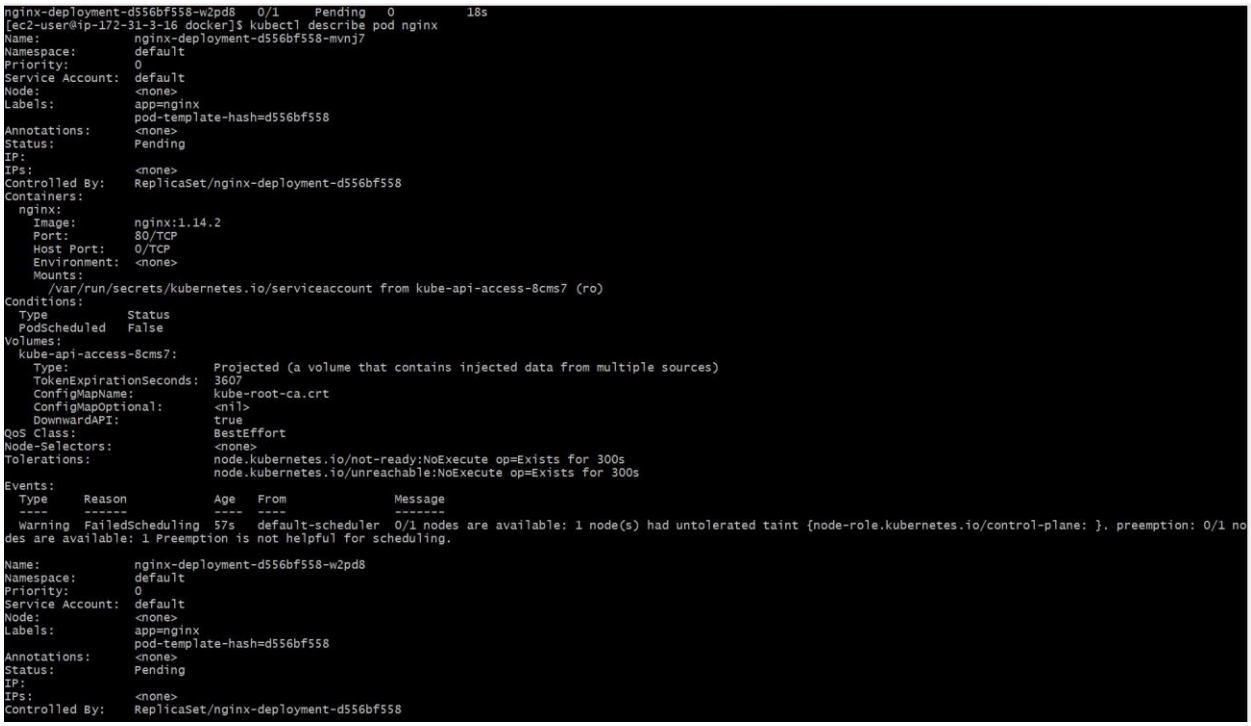
13. Now that the cluster is up and running, we can deploy our nginx server on this cluster. Apply this deployment file using this command to create a deployment
    kubectl apply -f https://k8s.io/examples/application/deployment.yaml

```
[ec2-user@ip-172-31-3-16 docker]$ kubectl apply -f https://k8s.io/examples/application/deployment.yaml
deployment.apps/nginx-deployment created
[ec2-user@ip-172-31-3-16 docker]$
```

14. Use kubectl get pods to check if the pod is working correctly.

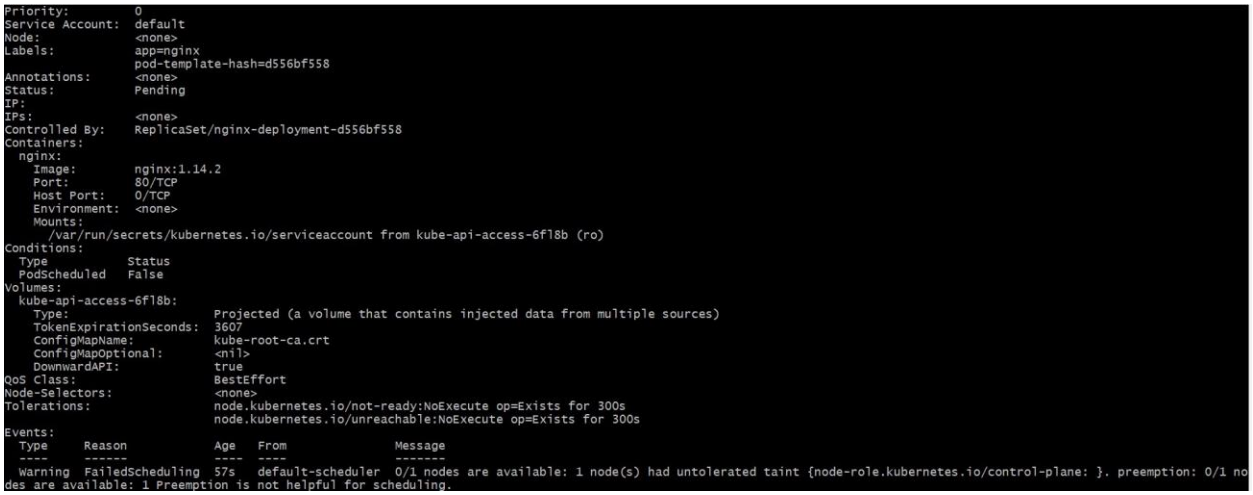
```
[ec2-user@ip-172-31-3-16 docker]$ kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
nginx-deployment-d556bf558-mvnj7   0/1     Pending   0          18s
nginx-deployment-d556bf558-w2pd8   0/1     Pending   0          18s
[ec2-user@ip-172-31-3-16 docker]$
```

15. To change status from pending to running use the following command: kubectl describe pod nginx.



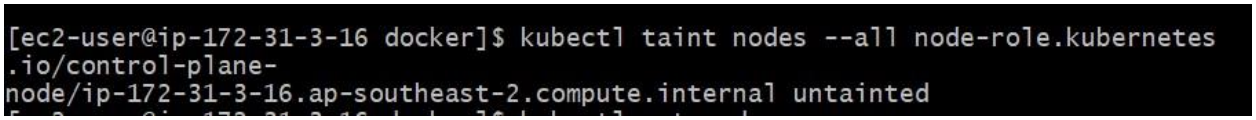
```
nginx-deployment-d556bf558-w2pd8   0/1     Pending   0          18s
[ec2-user@ip-172-31-3-16 docker]$ kubectl describe pod nginx
Name:             nginx-deployment-d556bf558-mvnj7
Namespace:        default
Priority:         0
Service Account:  default
Node:             <none>
Labels:           app=nginx
                  pod-template-hash=d556bf558
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Controlled By:    ReplicaSet/nginx-deployment-d556bf558
Containers:
  nginx:
    Image:        nginx:1.14.2
    Port:         80/TCP
    Host Port:    0/TCP
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-8cms7 (ro)
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  kube-api-access-8cms7:
    Type:                     Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:   3607
    ConfigMapName:            kube-root-ca.crt
    ConfigMapOptional:        <nil>
    DownwardAPI:              true
QoS Class:                    BestEffort
Node-Selectors:               <none>
Tolerations:                  node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                              node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason            Age   From               Message
  ----     ------            ----  ----               -------
  Warning  FailedScheduling  57s   default-scheduler  0/1 nodes are available: 1 node(s) had untolerated taint {node-role.kubernetes.io/control-plane: }. preemption: 0/1 no
des are available: 1 Preemption is not helpful for scheduling.

Name:             nginx-deployment-d556bf558-w2pd8
Namespace:        default
Priority:         0
Service Account:  default
Node:             <none>
Labels:           app=nginx
                  pod-template-hash=d556bf558
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Controlled By:    ReplicaSet/nginx-deployment-d556bf558
```



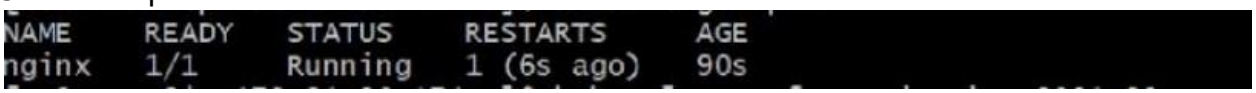
```
Priority:         0
Service Account:  default
Node:             <none>
Labels:           app=nginx
                  pod-template-hash=d556bf558
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Controlled By:    ReplicaSet/nginx-deployment-d556bf558
Containers:
  nginx:
    Image:        nginx:1.14.2
    Port:         80/TCP
    Host Port:    0/TCP
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-6fl8b (ro)
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  kube-api-access-6fl8b:
    Type:                     Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:   3607
    ConfigMapName:            kube-root-ca.crt
    ConfigMapOptional:        <nil>
    DownwardAPI:              true
QoS Class:                    BestEffort
Node-Selectors:               <none>
Tolerations:                  node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                              node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason            Age   From               Message
  ----     ------            ----  ----               -------
  Warning  FailedScheduling  57s   default-scheduler  0/1 nodes are available: 1 node(s) had untolerated taint {node-role.kubernetes.io/control-plane: }. preemption: 0/1 no
des are available: 1 Preemption is not helpful for scheduling.
```

Use the below command to remove taints.



```
[ec2-user@ip-172-31-3-16 docker]$ kubectl taint nodes --all node-role.kubernetes
.io/control-plane-
node/ip-172-31-3-16.ap-southeast-2.compute.internal untainted
```

16. Check the pod status.



```
NAME    READY   STATUS    RESTARTS      AGE
nginx   1/1     Running   1 (6s ago)    90s
```

17. port forward the deployment to your localhost so that you can view it

```
Forwarding from 127.0.0.1:8081 -> 80
Forwarding from [::1]:8081 -> 80
```

18. Verify your deployment Open up a new terminal and ssh to your EC2 instance.
    Then, use this curl command to check if the Nginx server is running.
    curl --head http://127.0.0.1:8080

Conclusion: In this experiment, we launched an EC2 instance and configured SSH access by updating the inbound rules. Next, we installed Docker and Kubernetes, and adjusted network settings to enable bridging. After completing the setup, we installed the Flannel networking plugin to ensure proper communication within the cluster. Once the cluster was up and running, we successfully deployed an NGINX server and verified its deployment.