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CaseStudy

Adv DevOps Case Study 2 Kubernetes Application Deployment

Main Problem Statement:

● Concepts Used: Kubernetes, AWS Cloud9 IDE, and Kubectl.

● Problem Statement: "Set up a Kubernetes cluster on AWS using the Cloud9 IDE.

Deploy a sample application using kubectl and ensure it runs successfully."

● Tasks:

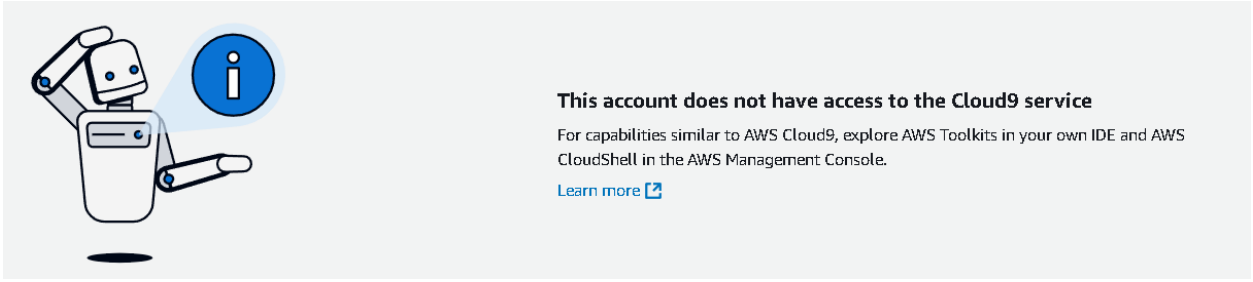
Install and configure kubectl using AWS Cloud9 IDE.

Deploy a sample application (like a simple Nginx server) on the Kubernetes clusters.

Verify the application deployment by accessing it through a NodePort or LoadBalancer.

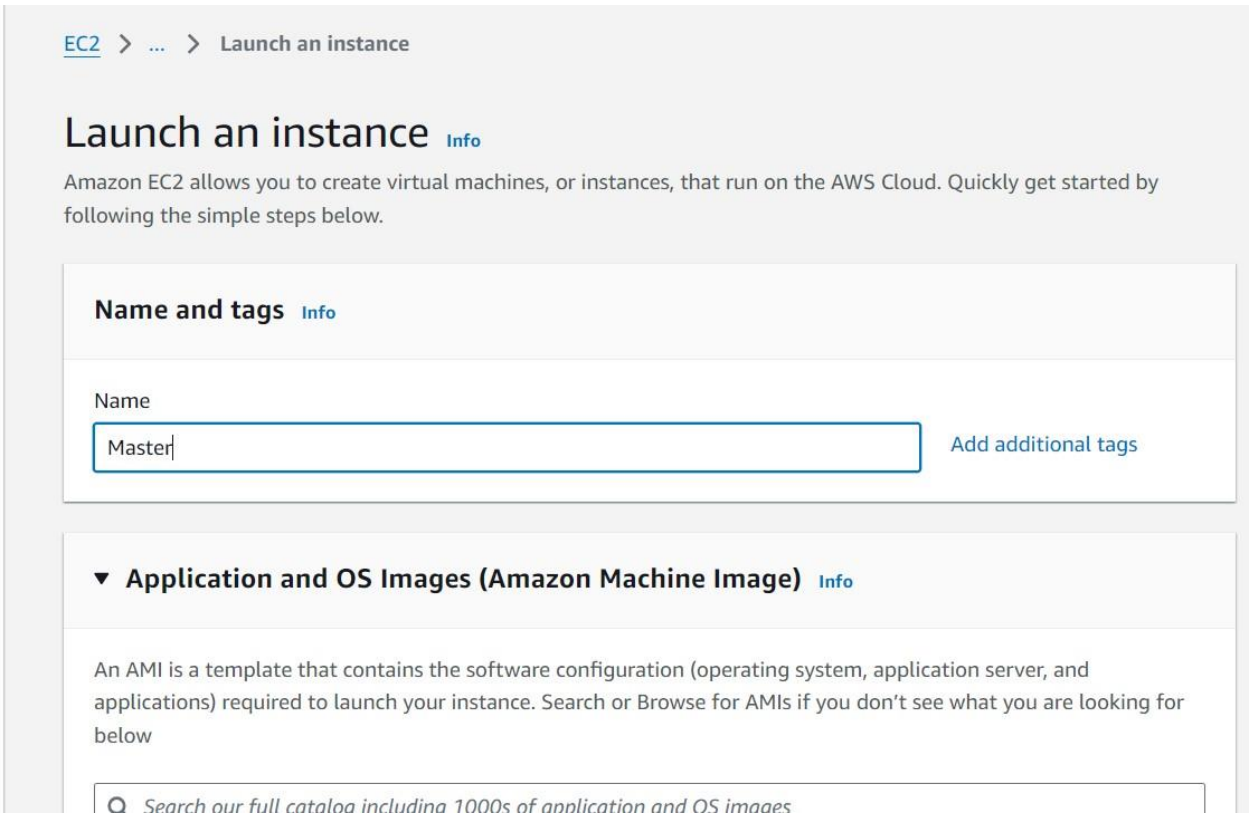
Note**

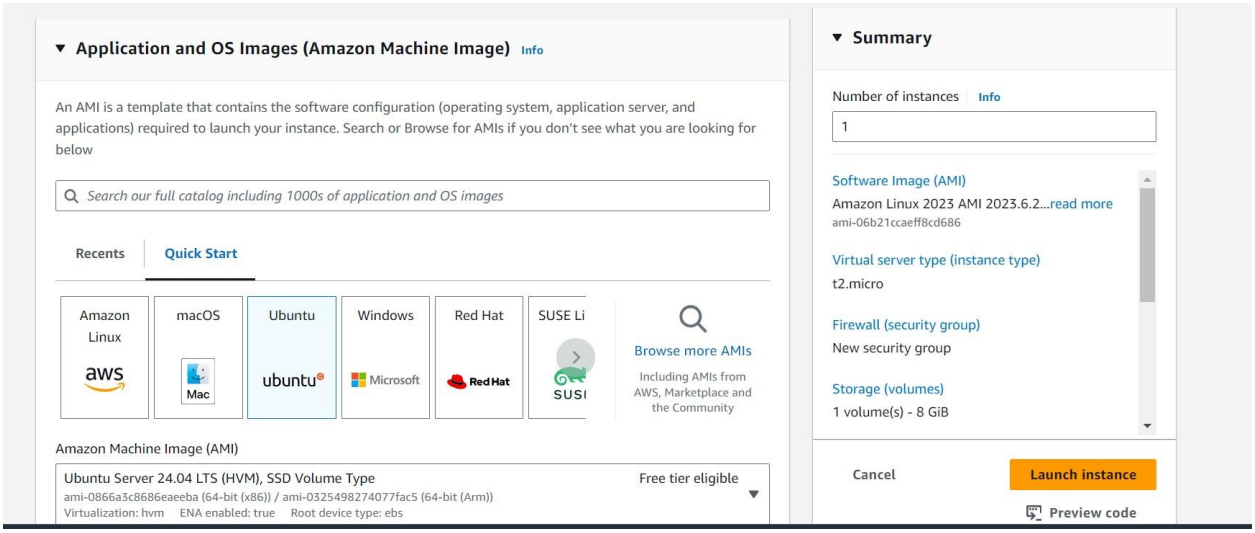
AWS Cloud9 has been discontinued, so we will now use EC2 for our development environment.



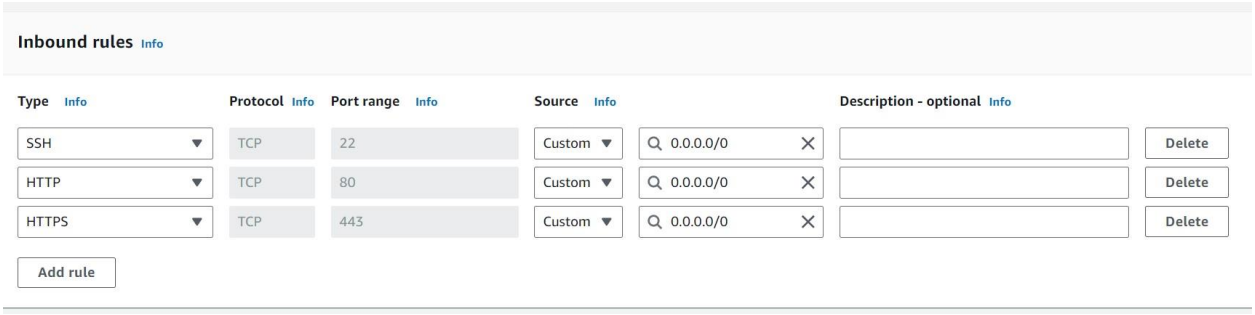
Steps:

1. Create an EC2 Ubuntu Instance on AWS.





2. Edit the Security Group Inbound Rules to allow SSH



3. SSH into the machine **ssh -i <keyname>.pem ubuntu@<public_ip_address>**

```
Lenovo@LAPTOP-8VIT9J4N MINGW64 ~/Downloads
$ ssh -i "adi.pem" ubuntu@ec2-54-221-25-104.compute-1.amazonaws.com
The authenticity of host 'ec2-54-221-25-104.compute-1.amazonaws.com (54.221.25.1
04)' can't be established.
ED25519 key fingerprint is SHA256:EQ7HQpmT3L+nP2hoSUtoRCa3ZtchelbW+LS36PE+qRQ.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-54-221-25-104.compute-1.amazonaws.com' (ED25519)
 to the list of known hosts.
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1016-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Mon Oct 21 03:33:17 UTC 2024

  System load:  0.06              Processes:             114
  Usage of /:   29.3% of 6.71GB   Users logged in:       1
  Memory usage: 27%               IPv4 address for enX0: 172.31.17.238
  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
```

Step 4: Run the below commands to install and setup Docker. 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-172-31-17-238:~$ sudo apt install docker.io -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  bridge-utils containerd dns-root-data dnsmasq-base pigz runc ubuntu-fan
Suggested packages:
  ifupdown aufs-tools cgroupfs-mount | cgroup-lite debootstrap docker-buildx
  docker-compose-v2 docker-doc rinse zfs-fuse | zfsutils
The following NEW packages will be installed:
  bridge-utils containerd dns-root-data dnsmasq-base docker.io pigz runc
  ubuntu-fan
0 upgraded, 8 newly installed, 0 to remove and 0 not upgraded.
Need to get 76.8 MB of archives.
After this operation, 289 MB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 pigz a
md64 2.8-1 [65.6 kB]
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 bridge-uti
ls amd64 1.7.1-1ubuntu2 [33.9 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 ru
nc amd64 1.1.12-0ubuntu3.1 [8599 kB]
Get:4 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 co
ntainerd amd64 1.7.12-0ubuntu4.1 [38.6 MB]
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 dns-root-d
ata all 2023112702~willsync1 [4450 B]
Get:6 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 dnsmasq-ba
se amd64 2.90-2build2 [375 kB]
Get:7 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd6
4 docker.io amd64 24.0.7-0ubuntu4.1 [29.1 MB]
Get:8 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 ubuntu
-fan all 0.12.16 [35.2 kB]
Fetched 76.8 MB in 2s (44.9 MB/s)
Preconfiguring packages ...
Selecting previously unselected package pigz.
(Reading database ... 98430 files and directories currently installed.)
Preparing to unpack .../0-pigz_2.8-1_amd64.deb ...
Unpacking pigz (2.8-1) ...
Selecting previously unselected package bridge-utils.
Preparing to unpack .../1-bridge-utils_1.7.1-1ubuntu2_amd64.deb ...
Unpacking bridge-utils (1.7.1-1ubuntu2) ...
```

sudo apt-get update

```
ubuntu@ip-172-31-80-240:~$ sudo apt-get update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 https://download.docker.com/linux/ubuntu noble InRelease
Hit:5 http://security.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
W: https://download.docker.com/linux/ubuntu/dists/noble/InRelease: The key(s) in the keyring /etc/apt/trusted.gpg.d/docker.gpg are ignored as the fil
e has an unsupported filetype.
W: https://download.docker.com/linux/ubuntu/dists/noble/InRelease: Key is stored in legacy trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPREC
ATION section in apt-key(8) for details.
ubuntu@ip-172-31-80-240:~$ sudo apt-get install -y docker-ce
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  containerd.io docker-buildx-plugin docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7 libslirp0 pigz slirp4netns
Suggested packages:
  aufs-tools cgroupfs-mount | cgroup-lite
The following NEW packages will be installed:
  containerd.io docker-buildx-plugin docker-ce docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7 libslirp0 pigz slirp4netns
0 upgraded, 10 newly installed, 0 to remove and 25 not upgraded.
Need to get 123 MB of archives.
After this operation, 442 MB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 pigz amd64 2.8-1 [65.6 kB]
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libltdl7 amd64 2.4.7-7build1 [40.3 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libslirp0 amd64 4.7.0-1ubuntu3 [63.8 kB]
Get:4 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 slirp4netns amd64 1.2.1-1build2 [34.9 kB]
Get:5 https://download.docker.com/linux/ubuntu noble/stable amd64 containerd.io amd64 1.7.22-1 [29.5 MB]
Get:6 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-buildx-plugin amd64 0.17.1-1~ubuntu.24.04~noble [30.3 MB]
```

sudo apt-get install -y docker-ce

```
ubuntu@ip-172-31-80-240:~$ sudo apt-get install -y docker-ce
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  containerd.io docker-buildx-plugin docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7 libslirp0 pigz slirp4netns
Suggested packages:
  aufs-tools cgroupfs-mount | cgroup-lite
The following NEW packages will be installed:
  containerd.io docker-buildx-plugin docker-ce docker-ce-cli docker-ce-rootless-extras docker-compose-plugin libltdl7 libslirp0 pigz slirp4netns
0 upgraded, 10 newly installed, 0 to remove and 25 not upgraded.
Need to get 123 MB of archives.
After this operation, 442 MB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 pigz amd64 2.8-1 [65.6 kB]
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libltdl7 amd64 2.4.7-7build1 [40.3 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libslirp0 amd64 4.7.0-1ubuntu3 [63.8 kB]
Get:4 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 slirp4netns amd64 1.2.1-1build2 [34.9 kB]
Get:5 https://download.docker.com/linux/ubuntu noble/stable amd64 containerd.io amd64 1.7.22-1 [29.5 MB]
Get:6 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-buildx-plugin amd64 0.17.1-1~ubuntu.24.04~noble [30.3 MB]
Get:7 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-ce-cli amd64 5:27.3.1-1~ubuntu.24.04~noble [15.0 MB]
Get:8 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-ce amd64 5:27.3.1-1~ubuntu.24.04~noble [25.6 MB]
Get:9 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-ce-rootless-extras amd64 5:27.3.1-1~ubuntu.24.04~noble [9588 kB]
Get:10 https://download.docker.com/linux/ubuntu noble/stable amd64 docker-compose-plugin amd64 2.29.7-1~ubuntu.24.04~noble [12.7 MB]
Fetched 123 MB in 2s (74.2 MB/s)
Selecting previously unselected package pigz.
(Reading database ... 67836 files and directories currently installed.)
Preparing to unpack .../0-pigz_2.8-1_amd64.deb ...
Unpacking pigz (2.8-1) ...
Selecting previously unselected package containerd.io.
Preparing to unpack .../1-containerd.io_1.7.22-1_amd64.deb ...
```

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

```
ubuntu@ip-172-31-80-240:~$ sudo mkdir -p /etc/docker
ubuntu@ip-172-31-80-240:~$ cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
```

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

```
ubuntu@ip-172-31-80-240:~$ sudo systemctl enable 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-172-31-80-240:~$ sudo systemctl daemon-reload
ubuntu@ip-172-31-80-240:~$ 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

Name:Aditya Ahuja Div:/Roll no:D15C/02

```
ubuntu@ip-172-31-80-240:~$ eecho 'deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /' | suc
o 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-172-31-80-240:~$
```

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

```
ubuntu@ip-172-31-80-240:~$ 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
Hit:2 https://download.docker.com/linux/ubuntu noble InRelease
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Hit:4 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:5 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:6 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes:/core:/stable:/v1.31/deb  InRelease
Fetched 126 kB in 1s (240 kB/s)
Reading package lists... Done
W: https://download.docker.com/linux/ubuntu/dists/noble/InRelease: The key(s) in the keyring /etc/apt/trusted.gpg.d/docker.gpg are ignored as the fil
e has an unsupported filetype.
W: https://download.docker.com/linux/ubuntu/dists/noble/InRelease: Key is stored in legacy trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPREC
ATION section in apt-key(8) for details.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
kubelet is already the newest version (1.31.1-1.1).
kubeadm is already the newest version (1.31.1-1.1).
kubectl is already the newest version (1.31.1-1.1).
0 upgraded, 0 newly installed, 0 to remove and 25 not upgraded.
kubelet was already set on hold.
kubeadm was already set on hold.
kubectl was already set on hold.
```

sudo systemctl enable --now kubelet
sudo kubeadm init --pod-network-cidr=10.244.0.0/16

```
ubuntu@ip-172-31-80-240:~$ sudo systemctl enable --now kubelet
sudo kubeadm init --pod-network-cidr=10.244.0.0/16
[init] Using Kubernetes version: v1.31.1
[preflight] Running pre-flight checks
W1020 10:02:22.795027    5411 checks.go:1080] [preflight] WARNING: Couldn't create the interface used for talking to the container runtime: failed t
 create new CRI runtime service: validate service connection: validate CRI v1 runtime API for endpoint "unix:///var/run/containerd/containerd.sock":
rpc error: code = Unimplemented desc = unknown service runtime.v1.RuntimeService
        [WARNING FileExisting-socat]: socat not found in system path
[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'
error execution phase preflight: [preflight] Some fatal errors occurred:
failed to create new CRI runtime service: validate service connection: validate CRI v1 runtime API for endpoint "unix:///var/run/containerd/containe
d.sock": rpc error: code = Unimplemented desc = unknown service runtime.v1.RuntimeService[preflight] If you know what you are doing, you can make a
heck non-fatal with `--ignore-preflight-errors=...`
To see the stack trace of this error execute with --v=5 or higher
ubuntu@ip-172-31-80-240:~$
```

sudo apt-get install -y containerd

```
ubuntu@ip-172-31-80-240:~$ 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 libslirp0 pigz slirp4netns
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  runc
The following packages will be REMOVED:
  containerd.io docker-ce
The following NEW packages will be installed:
  containerd runc
0 upgraded, 2 newly installed, 2 to remove and 25 not upgraded.
Need to get 47.2 MB of archives.
After this operation, 53.1 MB disk space will be freed.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 runc amd64 1.1.12-0ubuntu3.1 [8599 kB]
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 containerd amd64 1.7.12-0ubuntu4.1 [38.6 MB]
Fetched 47.2 MB in 1s (70.4 MB/s)
(Reading database ... 68159 files and directories currently installed.)
Removing docker-ce (5:27.3.1-1~ubuntu.24.04~noble) ...
Removing containerd.io (1.7.22-1) ...
Selecting previously unselected package runc.
(Reading database ... 68139 files and directories currently installed.)
Preparing to unpack .../runc_1.1.12-0ubuntu3.1_amd64.deb ...
Unpacking runc (1.1.12-0ubuntu3.1) ...
Selecting previously unselected package containerd.
Preparing to unpack .../containerd_1.7.12-0ubuntu4.1_amd64.deb ...
```

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

Name:Aditya Ahuja Div:/Roll no:D15C/02

```
ubuntu@ip-172-31-80-240:~$ 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 = ""
version = 2

[cgroup]
  path = ""

[debug]
  address = ""
  format = ""
  gid = 0
  level = ""
  uid = 0

[grpc]
  address = "/run/containerd/containerd.sock"
  gid = 0
  max_recv_message_size = 16777216
  max_send_message_size = 16777216
  tcp_address = ""
  tcp_tls_ca = ""
  tcp_tls_cert = ""
```

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

```
ubuntu@ip-172-31-80-240:~$ sudo systemctl restart containerd
ubuntu@ip-172-31-80-240:~$ sudo systemctl enable containerd
ubuntu@ip-172-31-80-240:~$ sudo systemctl status containerd
● containerd.service - containerd container runtime
     Loaded: loaded (/usr/lib/systemd/system/containerd.service; enabled; preset: enabled)
     Active: active (running) since Sun 2024-10-20 10:05:40 UTC; 21s ago
       Docs: https://containerd.io
   Main PID: 5885 (containerd)
      Tasks: 8
     Memory: 13.1M (peak: 13.9M)
        CPU: 129ms
     CGroup: /system.slice/containerd.service
             └─5885 /usr/bin/containerd

Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.905924648Z" level=error msg="failed to load cni during init, please chec
k>
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906093670Z" level=info msg="Start subscribing containerd event"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906132437Z" level=info msg=serving... address=/run/containerd/containerd
.>
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906135956Z" level=info msg="Start recovering state"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906185395Z" level=info msg=serving... address=/run/containerd/containerd
.>
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906205371Z" level=info msg="Start event monitor"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906215409Z" level=info msg="Start snapshots syncer"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906223526Z" level=info msg="Start cni network conf syncer for default"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906229655Z" level=info msg="Start streaming server"
Oct 20 10:05:40 ip-172-31-80-240 containerd[5885]: time="2024-10-20T10:05:40.906282756Z" level=info msg="containerd successfully booted in 0.028768s"
lines 1-21/21 (END)
```

sudo apt-get install -y socat

```
ubuntu@ip-172-31-80-240:~$ 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 libslirp0 pigz slirp4netns
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  socat
0 upgraded, 1 newly installed, 0 to remove and 25 not upgraded.
Need to get 374 kB of archives.
After this operation, 1649 kB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 socat amd64 1.8.0.0-4build3 [374 kB]
Fetched 374 kB in 0s (11.8 MB/s)
Selecting previously unselected package socat.
(Reading database ... 68203 files and directories currently installed.)
Preparing to unpack .../socat_1.8.0.0-4build3_amd64.deb ...
Unpacking socat (1.8.0.0-4build3) ...
Setting up socat (1.8.0.0-4build3) ...
Processing triggers for man-db (2.12.0-4build2) ...
Scanning processes... [
Scanning processes... [=
Scanning processes... [==
Scanning processes... [===
Scanning processes... [====
Scanning processes... [=====
Scanning processes... [======
Scanning processes... [=======
Scanning processes... [========
```

Step 6: Initialize the Kubecluster
sudo kubeadm init --pod-network-cidr=10.244.0.0/16

```
ubuntu@ip-172-31-80-240:~$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16
[init] Using Kubernetes version: v1.31.1
[preflight] Running pre-flight checks
[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'
W1020 10:07:42.067638    6134 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.8" of the container runtime is inconsistent wi
h that used by kubeadm.It is recommended to use "registry.k8s.io/pause:3.10" 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-172-31-80-240 kubernetes kubernetes.default kubernetes.default.svc kubernetes.default.svc
cluster.local] and IPs [10.96.0.1 172.31.80.240]
[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-172-31-80-240 localhost] and IPs [172.31.80.240 127.0.0.1 ::1]
[certs] Generating "etcd/peer" certificate and key
[certs] etcd/peer serving cert is signed for DNS names [ip-172-31-80-240 localhost] and IPs [172.31.80.240 127.0.0.1 ::1]
[certs] Generating "etcd/healthcheck-client" certificate and key
[certs] Generating "apiserver-etcd-client" certificate and key
[certs] Generating "sa" key and public key
[kubeconfig] Using kubeconfig folder "/etc/kubernetes"
[kubeconfig] Writing "admin.conf" kubeconfig file
[kubeconfig] Writing "super-admin.conf" kubeconfig file
[kubeconfig] Writing "kubelet.conf" kubeconfig file
[kubeconfig] Writing "controller-manager.conf" kubeconfig file
```

Copy the mkdir and chown commands from the top and execute them. 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-172-31-80-240:~$ mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

Add a common networking plugin called flannel as mentioned in the code.
kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

```
ubuntu@ip-172-31-80-240:~$ 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
```

kubectl apply -f https://k8s.io/examples/application/deployment.yaml

```
ubuntu@ip-172-31-80-240:~$  kubectl apply -f https://k8s.io/examples/application/deployment.yaml
deployment.apps/nginx-deployment created
```

kubectl get pods

```
ubuntu@ip-172-31-80-240:~$ kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
nginx-deployment-d556bf558-87mfp   0/1     Pending   0          26s
nginx-deployment-d556bf558-fcfx2   0/1     Pending   0          26s
```

POD_NAME =$(kubectl get pods -l app=nginx -o jsonpath = “{.item[0].metadata.name}”)

```
ubuntu@ip-172-31-80-240:~$ POD_NAME=$(kubectl get pods -l app=nginx -o jsonpath="{.items[0].metadata.name}")
kubectl port-forward $POD_NAME 8080:80
error: unable to forward port because pod is not running. Current status=Pending
```

kubectl get nodes

```
ubuntu@ip-172-31-80-240:~$  kubectl get nodes
NAME                STATUS   ROLES           AGE     VERSION
ip-172-31-80-240    Ready    control-plane   3m46s   v1.31.1
```

POD_NAME=$(kubectl get pods -l app=nginx -o jsonpath="{.items[0].metadata.name}")
kubectl port-forward $POD_NAME 8080:80

```
ubuntu@ip-172-31-80-240:~$ POD_NAME=$(kubectl get pods -l app=nginx -o jsonpath="{.items[0].metadata.name}")
ubuntu@ip-172-31-80-240:~$ kubectl port-forward $POD_NAME 8080:80
error: unable to forward port because pod is not running. Current status=Pending
```

command kubectl tain tnodes--all node-role.kubernetes.io/control-plane-node/ip-172-3120-171 untainted

```
ubuntu@ip-172-31-80-240:~$ command kubectl taint nodes --all node-role.kubernetes.io/control-plane:NoSchedule-
node/ip-172-31-80-240 untainted
```

kubectl get nodes

```
ubuntu@ip-172-31-80-240:~$ kubectl get nodes
NAME                STATUS   ROLES           AGE     VERSION
ip-172-31-80-240    Ready    control-plane   9m52s   v1.31.1
```

kubectl get pods

```
ubuntu@ip-172-31-80-240:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-d556bf558-87mfp    1/1     Running   0          8m
nginx-deployment-d556bf558-fcfx2    1/1     Running   0          8m
```

POD_NAME=$(kubectl get pods -l app=nginx -o jsonpath="{.items[0].metadata.name}")
kubectl port-forward $POD_NAME 8082:80

```
ubuntu@ip-172-31-80-240:~$ kubectl port-forward nginx-deployment-d556bf558-87mfp 8082:80
Forwarding from 127.0.0.1:8082 -> 80
Forwarding from [::1]:8082 -> 80
Handling connection for 8082
```

Step 8: 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://127.0.0.1:8082

Name:Aditya Ahuja Div:/Roll no:D15C/02

```
ubuntu@ip-172-31-80-240:~$ curl --head http://127.0.0.1:8082
HTTP/1.1 200 OK
Server: nginx/1.14.2
Date: Sun, 20 Oct 2024 10:20:51 GMT
Content-Type: text/html
Content-Length: 612
Last-Modified: Tue, 04 Dec 2018 14:44:49 GMT
Connection: keep-alive
ETag: "5c0692e1-264"
Accept-Ranges: bytes
```

kubectl get services

```
ubuntu@ip-172-31-80-240:~$ kubectl get services
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   29m
```

kubectl create deployment nginx –image=nginx

```
ubuntu@ip-172-31-80-240:~$ kubectl create deployment nginx --image=nginx
deployment.apps/nginx created
```

kubectl get deployments

```
ubuntu@ip-172-31-80-240:~$ kubectl get deployments
NAME               READY   UP-TO-DATE   AVAILABLE   AGE
nginx              1/1     1            1           11s
nginx-deployment   2/2     2            2           29m
```

kubectl expose deployment nginx --type=NodePort --port=80

```
ubuntu@ip-172-31-80-240:~$ kubectl expose deployment nginx --type=NodePort --port=80
service/nginx exposed
```

Nginx server is running successfully on the EC2 instance, and it's accessible locally via localhost on port 31801.
curl http://127.0.0.1/31344

```
ubuntu@ip-172-31-20-62:~$ curl http://172.31.20.62:31344
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
```

Conclusion:

In this experiment, we successfully set up Kubernetes and Docker on an AWS EC2 Ubuntu instance, configured the necessary settings, and initialized a Kubernetes cluster. We deployed an Nginx server using a Kubernetes Deployment and implemented the Flannel

networking plugin for pod communication. By checking the pod status and forwarding ports, we were able to access the Nginx server locally. The successful `200 OK` response from the `curl` command confirmed that the deployment was functioning correctly. This setup highlighted key Kubernetes operations, such as cluster management, application deployment, and verification, demonstrating the effectiveness of Kubernetes in orchestrating containerized applications efficiently.