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Advanced DevOps Lab Experiment 4

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

Theory:

Kubernetes, often referred to as K8s, is an open-source container orchestration platform that automates the deployment, scaling, and management of containerized applications. Originally developed by Google, it has become the industry standard for managing container workloads due to its flexibility and robust features.

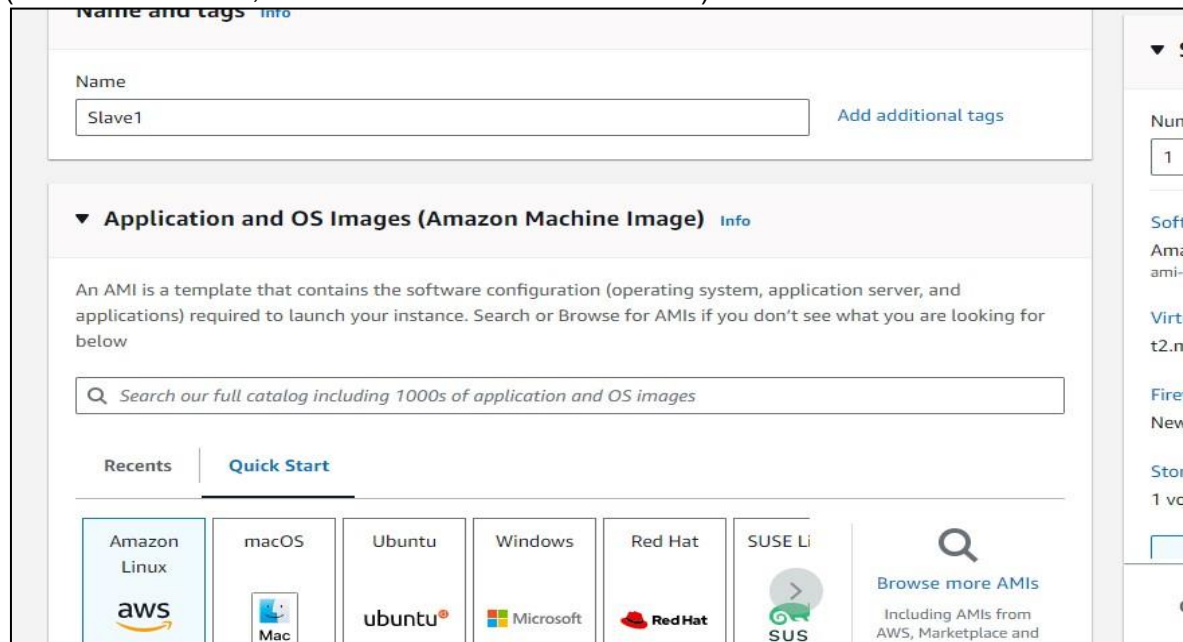
Steps:

1. Create 3 EC2 Ubuntu Instances on AWS.

Extra:

When we select ubuntu we have to select an older version - 22.04.

(Name 1 as Master, the other 2 as Slave1 and Slave2)



2. Now click on connect to instance, then click on SSH client.

3. Now copy the ssh from the example and paste it on command prompt.(I used gitbash)

EC2 > Instances > i-02d0bd51d43449e29 > Connect to instance

Connect to instance Info

Connect to your instance i-02d0bd51d43449e29 (Master) using any of these options

EC2 Instance Connect

Session Manager

SSH client

EC2 serial console

Instance ID
i-02d0bd51d43449e29 (Master)

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is `kubernetes.pem`
3. Run this command, if necessary, to ensure your key is not publicly viewable.
`chmod 400 "kubernetes.pem"`
4. Connect to your instance using its Public DNS:
`ec2-54-164-13-87.compute-1.amazonaws.com`

Example:
`ssh -i "kubernetes.pem" ubuntu@ec2-54-164-13-87.compute-1.amazonaws.com`

```
Running scriptlet: docker-25.0.6-1.amzn2023.0.1.x86_64
Installing      : docker-25.0.6-1.amzn2023.0.1.x86_64
Running scriptlet: docker-25.0.6-1.amzn2023.0.1.x86_64
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
Verifying      : docker-25.0.6-1.amzn2023.0.1.x86_64
Verifying      : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64
Verifying      : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64
Verifying      : libcgrou-3.0-1.amzn2023.0.1.x86_64
Verifying      : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64
Verifying      : libnftnl-1.0.1-19.amzn2023.0.2.x86_64
Verifying      : libnftnl-1.2.2-2.amzn2023.0.2.x86_64
Verifying      : pigz-2.5-1.amzn2023.0.3.x86_64
Verifying      : runc-1.1.11-1.amzn2023.0.1.x86_64

Installed:
containerd-1.7.20-1.amzn2023.0.1.x86_64    docker-25.0.6-1.amzn2023.0.1.x86_64    iptables-libs-1.8.8-3.amzn2023.0.2.x86_64
iptables-nft-1.8.8-3.amzn2023.0.2.x86_64    libcgrou-3.0-1.amzn2023.0.1.x86_64    libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64
libnftnl-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-1.1.11-1.amzn2023.0.1.x86_64

Complete!
```

Commands:

4. Now since you are on GitBash, first type `sudo su` to perform the command as a root user.

5. After this type on GitBash

Yum install docker -y

```
[ec2-user@ip-172-31-84-37 ~]$ sudo su
[root@ip-172-31-84-37 ec2-user]# yum install docker -y
Last metadata expiration check: 0:18:22 ago on Thu Aug 29 08:52:52 2024.
Dependencies resolved.
```

Package	Architecture	Version	Repository	Size
Installing:				
docker	x86_64	25.0.6-1.amzn2023.0.1	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
libnftnl	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
pkgconf	x86_64	2.5-1.amzn2023.0.3	amazonlinux	83 k
runC	x86_64	1.1.11-1.amzn2023.0.1	amazonlinux	3.0 M

6. To start the docker perform this command: `Systemctl start docker`

7. To check if docker is Installed successfully:

`Docker -v` or `Docker --version`

```
[root@ip-172-31-84-37 ec2-user]# systemctl start docker
[root@ip-172-31-84-37 ec2-user]# sudo su
[root@ip-172-31-84-37 ec2-user]# yum repolist
repo id                                repo name
amazonlinux                            Amazon Linux 2023 repository
kernel-livepatch                       Amazon Linux 2023 Kernel Livepatch repository
[root@ip-172-31-84-37 ec2-user]# docker --version
Docker version 25.0.5, build 5dc9bcc
```

8. Now to install kubeadm :

Installing kubeadm:

Go the official documentation off kubeadm.

The screenshot shows the Kubernetes documentation website. The top navigation bar includes links for Documentation, Kubernetes Blog, Training, Partners, Community, Case Studies, Versions, and English. The sidebar on the left has a search bar and a list of navigation links: Documentation, Getting started, Learning environment, Production environment, Container Runtimes, Installing Kubernetes with deployment tools, Bootstrapping clusters with kubeadm, Installing kubeadm, Troubleshooting kubeadm, Creating a cluster with kubeadm, and Before you begin. The main content area is titled 'Installing kubeadm' and contains the following text: 'This page shows how to install the kubeadm toolbox. For information on how to create a cluster with kubeadm once you have performed this installation process, see the Creating a cluster with kubeadm page. This installation guide is for Kubernetes v1.31. If you want to use a different Kubernetes version, please refer to the following pages instead: Installing kubeadm (Kubernetes v1.30), Installing kubeadm (Kubernetes v1.29), Installing kubeadm (Kubernetes v1.28), Installing kubeadm (Kubernetes v1.27)'. The sidebar also includes a 'Before you begin' section with links for Verify the MAC address, Check network address, Check required ports, Swap configuration, Installing a container, Installing kubeadm, Configuring a cgroup, Troubleshooting, and What's next.

9. Scroll down and select Red Hat based distributions:

Debian-based distributions

Red Hat-based distributions

Without a package manager

1. Set SELinux to `permissive` mode:

These instructions are for Kubernetes 1.31.

```
# Set SELinux in permissive mode (effectively disabling it)
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

10. Now copy the command:

Set SELinux to permissive mode:

These instructions are for Kubernetes 1.31.

```
# Set SELinux in permissive mode (effectively disabling it) sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/'
/etc/selinux/config
```

11. Now copy all the commands on the GitBash:

```
# This overwrites any existing configuration in /etc/yum.repos.d/kubernetes.repo
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.ke
y exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
```

```
#Install kubelet, kubeadm and kubectl: sudo yum install -y kubelet
```

```
kubeadm kubectl --disableexcludes=kubernetes #(Optional) Enable the
```

```
kubelet service before running kubeadm:
```

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

```
Installing      : kubeadm-1.31.0-150500.1.1.x86_64
Installing      : kubectl-1.31.0-150500.1.1.x86_64
Running scriptlet: kubectl-1.31.0-150500.1.1.x86_64
Verifying       : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64
Verifying       : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64
Verifying       : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64
Verifying       : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64
Verifying       : socat-1.7.4.2-1.amzn2023.0.2.x86_64
Verifying       : cri-tools-1.31.1-150500.1.1.x86_64
Verifying       : kubeadm-1.31.0-150500.1.1.x86_64
Verifying       : kubectl-1.31.0-150500.1.1.x86_64
Verifying       : kubelet-1.31.0-150500.1.1.x86_64
Verifying       : kubernetes-cni-1.5.0-150500.2.1.x86_64

Installed:
  conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64      cr
  kubeadm-1.31.0-150500.1.1.x86_64                ku
  kubelet-1.31.0-150500.1.1.x86_64                ku
  libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64  li
  libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64    so

Complete!
[root@ip-172-31-84-37 ec2-user]# sudo systemctl enable --now kubelet
```

12. Type yum repolist to check the repository of kubernetes

```
[root@ip-172-31-84-143 ec2-user]# yum repolist
repo id                                repo name
amazonlinux                            Amazon Linux 2023 repository
kernel-livepatch                       Amazon Linux 2023 Kernel Livepatch repository
kubernetes                             Kubernetes
```

EXTRA

Got an error in initialization kubeadm

```
[root@ip-172-31-31-240 ec2-user]# kubeadm init
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
W0908 11:25:45.820964    2320 checks.go:1080] [preflight] WARNING: Couldn't create the interface used for talking to
CRI runtime service: validate service connection: validate CRI v1 runtime API for endpoint "unix:///var/run/contain
ple desc = connection error: desc = "transport: Error while dialing: dial unix /var/run/containerd/containerd.sock:
[WARNING FileExisting-tc]: tc not found in system path
error execution phase preflight: [preflight] Some fatal errors occurred:
[ERROR FileContent--proc-sys-net-ipv4-ip_forward]: /proc/sys/net/ipv4/ip_forward contents are not set to 1
[preflight] If you know what you are doing, you can make a check non-fatal with `--ignore-preflight-errors=...`
To see the stack trace of this error execute with --v=5 or higher
```

Error was resolved:

(after again starting from scratch)

13. Initialize the kubeadm by the command kubeadm init :

Kubeadm initialized successfully:

```
[root@ip-172-31-26-66 ec2-user]# kubeadm init
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
[WARNING FileExisting-socat]: socat not found in system path
[WARNING FileExisting-tc]: tc 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
[preflight] You can also perform this action beforehand using 'kubeadm config images pull'
W0912 06:07:49.475553    28037 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.10" as the
that used by kubeadm.It is recommended to use "registry.k8s.io/pause:3.10" as the
[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-172-31-26-66.ec2.internal
efault.svc.cluster.local] and IPs [10.96.0.1 172.31.26.66]
[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
```

14. After this we will get 3 things:

- The directory
- Some export Statement
- The most important thing - the token to connect the slaves with the master.

15. Copy them

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 172.31.26.66:6443 --token grw4r4.gb3kkhb7392dnvjp \
--discovery-token-ca-cert-hash sha256:b61f1de7eedb2c0dc0cc237d4629e9631920b63dd6634c3e22e76aaa36d01920
```

16. After pasting type kubectl get nodes:

The nodes are connected successfully:

```
ubuntu@ip-172-31-17-23:~$ kubectl get nodes
NAME                STATUS    ROLES    AGE   VERSION
ip-172-31-17-23     Ready    control-plane   3m56s   v1.29.0
ip-172-31-18-12     Ready    <none>         37s     v1.29.0
ip-172-31-26-153     Ready    <none>         24s     v1.29.0
ubuntu@ip-172-31-17-23:~$ kubectl get nodes
NAME                STATUS    ROLES    AGE   VERSION
ip-172-31-17-23     Ready    control-plane   9m34s   v1.29.0
ip-172-31-18-12     Ready    <none>         6m15s   v1.29.0
ip-172-31-26-153     Ready    <none>         6m2s    v1.29.0
ubuntu@ip-172-31-17-23:~$ |
```

17. Create two YAML files named nginx-deployment.yaml and nginx-service.yaml

(I used nano editor for the same)

```
ubuntu@ip-172-31-17-23:~$ nano nginx-deployment.yaml
ubuntu@ip-172-31-17-23:~$ nano nginx-service.yaml
```

18. Then add the deployment and service configuration in it, respectively:

Deployment:

```
GNU nano 6.2 nginx-deployment.yaml *
name: nginx-deployment
labels:
  app: nginx
spec:
  replicas: 2
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:1.21.3
        ports:
        - containerPort: 80

^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^/ Go To Line
```

Service:

```
GNU nano 6.2 nginx-service.yaml *
apiVersion: v1
kind: Service
metadata:
  name: nginx-service
spec:
  selector:
    app: nginx
  ports:
  - protocol: TCP
    port: 80
    targetPort: 80
  type: LoadBalancer

^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^/ Go To Line
```


19. Now since we have configured our files we would now proceed for applying both the deployment and the service files.

Deployment :

```
ubuntu@ip-172-31-17-23:~$ kubectl apply -f nginx-deployment.yaml
deployment.apps/nginx-deployment created
```

Service:

```
ubuntu@ip-172-31-17-23:~$ kubectl apply -f nginx-service.yaml
service/nginx-service created
```

20. After deployment its time for verifying the same:

For deployment:

```
ubuntu@ip-172-31-17-23:~$ kubectl get deployments
NAME                READY   UP-TO-DATE   AVAILABLE   AGE
nginx                1/1     1             1           14m
nginx-deployment     2/2     2             2           39s
```

For services:

```
ubuntu@ip-172-31-17-23:~$ kubectl get services
NAME                TYPE        CLUSTER-IP      EXTERNAL-IP   PORT
(s)                AGE
kubernetes          ClusterIP   10.96.0.1       <none>        443/TCP
nginx                NodePort    10.109.245.143  <none>        80:30306/TCP
nginx-service        LoadBalancer 10.99.247.105   <pending>     80:31130/TCP
```

For pods:

```
ubuntu@ip-172-31-17-23:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AG
nginx-7854ff8877-mxrqg              1/1     Running   0           15
nginx-deployment-6b4d6fdbf-5rb6h    1/1     Running   0           65
nginx-deployment-6b4d6fdbf-6q2jj    1/1     Running   0           65
```

Extra:

```
ubuntu@ip-172-31-17-23:~$ kubectl get namespaces
NAME                STATUS    AGE
default             Active   55m
kube-node-lease     Active   55m
kube-public         Active   55m
kube-system         Active   55m
```

21. Now Lastly, port forward the deployment to your localhost so that you can view it.

```
ubuntu@ip-172-31-17-23:~$ kubectl port-forward service/nginx 8080:80
Forwarding from 127.0.0.1:8080 -> 80
Forwarding from [::1]:8080 -> 80
```

22. You can open the browser and check on

<http://localhost:8080>

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.