Lab 7 - Kubernetes

Initialize cluster

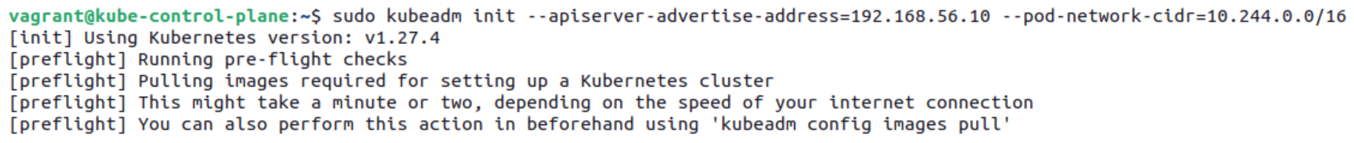
1. To free up resources, stop all vagrant VMs in devop-lab environment.
   - Clone the following Git repository :

   https://github.com/brahimhamdi/k8s-lab
   - In k8s-lab directory, execute following command to deploy k8s vagrants VMs :

     vagrant up

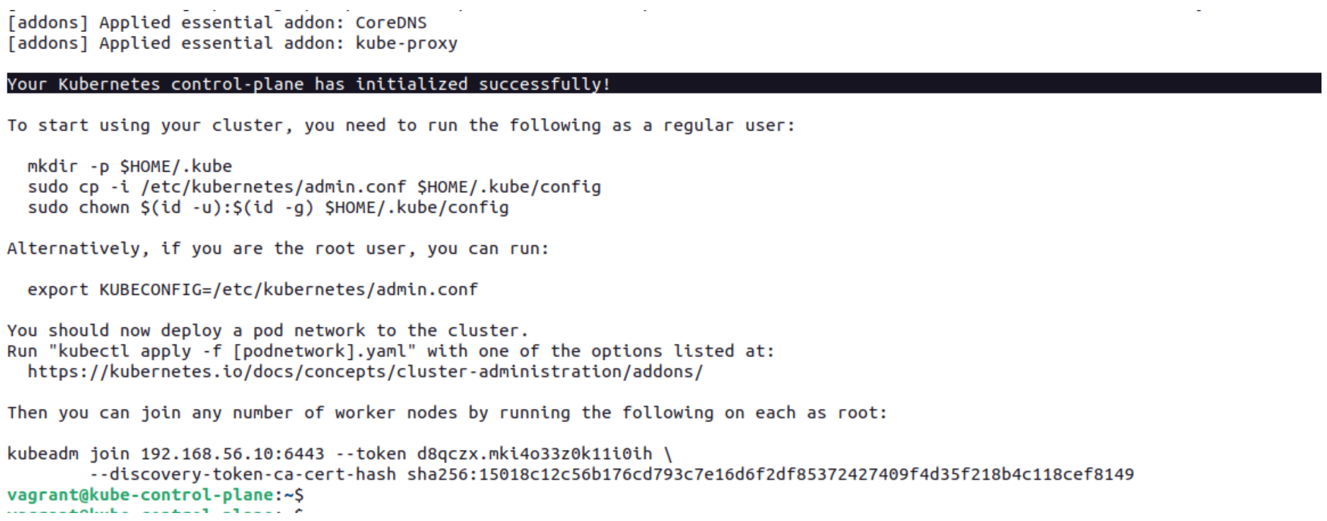
2. Kubernetes is already installed on all vagrant VMs. On master VM, initialize the cluster.

sudo kubeadm init --apiserver-advertise-address=192.168.56.10 --pod-network-cidr=10.244.0.0/16



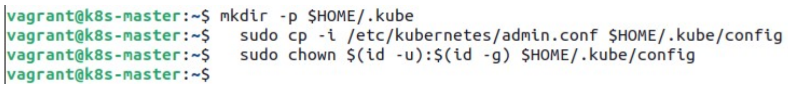
```
vagrant@kube-control-plane:~$ sudo kubeadm init --apiserver-advertise-address=192.168.56.10 --pod-network-cidr=10.244.0.0/16
[init] Using Kubernetes version: v1.27.4
[preflight] Running pre-flight checks
[preflight] Pulling images required for setting up a Kubernetes cluster
[preflight] This might take a minute or two, depending on the speed of your internet connection
[preflight] You can also perform this action in beforehand using 'kubeadm config images pull'
```

   - If no errors, what's the output of the initializing command ?



```
[addons] Applied essential addon: CoreDNS
[addons] Applied essential addon: kube-proxy

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 192.168.56.10:6443 --token d8qczx.mki4o33z0k11i0ih \
        --discovery-token-ca-cert-hash sha256:15018c12c56b176cd793c7e16d6f2df85372427409f4d35f218b4c118cef8149
vagrant@kube-control-plane:~$
```

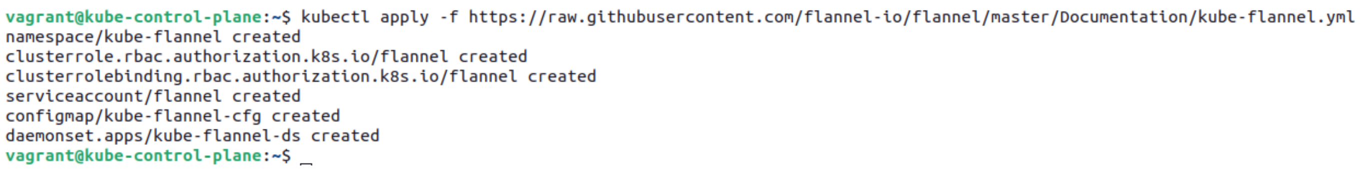
- To start using your cluster as regular user, apply next commands



```
vagrant@k8s-master:~$ mkdir -p $HOME/.kube
vagrant@k8s-master:~$   sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
vagrant@k8s-master:~$   sudo chown $(id -u):$(id -g) $HOME/.kube/config
vagrant@k8s-master:~$
```

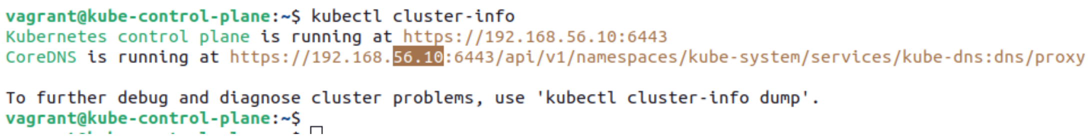
- Apply flannel yaml file.

kubectl apply -f https://raw.githubusercontent.com/flannel-io/flannel/master/Documentation/kube-flannel.yml



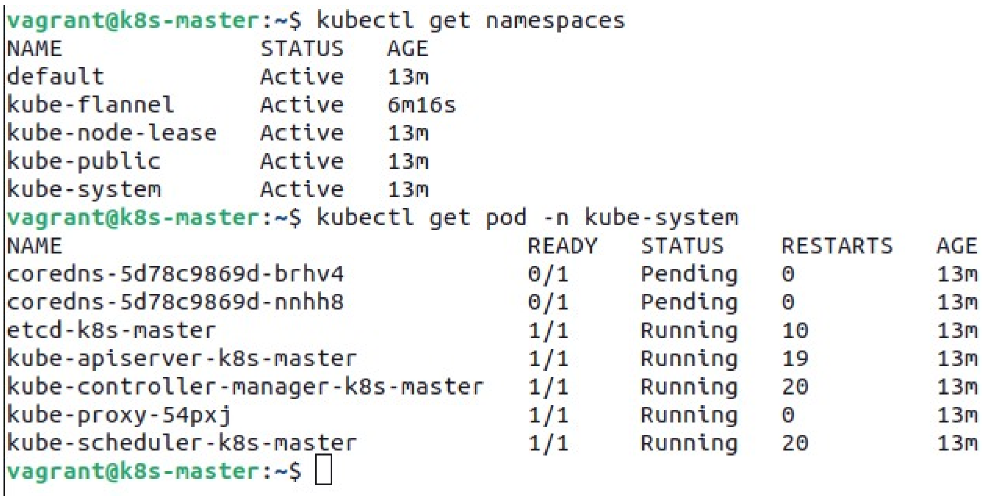
```
vagrant@kube-control-plane:~$ kubectl apply -f https://raw.githubusercontent.com/flannel-io/flannel/master/Documentation/kube-flannel.yml
namespace/kube-flannel created
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
serviceaccount/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
vagrant@kube-control-plane:~$ _
```

3. Check the cluster info.



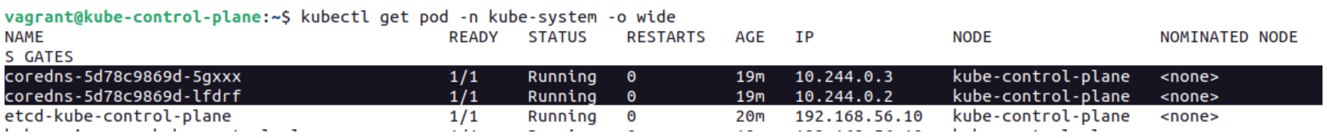
```
vagrant@kube-control-plane:~$ kubectl cluster-info
Kubernetes control plane is running at https://192.168.56.10:6443
CoreDNS is running at https://192.168.56.10:6443/api/v1/namespaces/kube-system/services/kube-dns:dns/proxy

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
vagrant@kube-control-plane:~$
```

- How kubernetes components looks like ?



```
vagrant@k8s-master:~$ kubectl get namespaces
NAME              STATUS   AGE
default           Active   13m
kube-flannel      Active   6m16s
kube-node-lease   Active   13m
kube-public       Active   13m
kube-system       Active   13m
vagrant@k8s-master:~$ kubectl get pod -n kube-system
NAME                                 READY   STATUS    RESTARTS   AGE
coredns-5d78c9869d-brhv4             0/1     Pending   0          13m
coredns-5d78c9869d-nnhh8             0/1     Pending   0          13m
etcd-k8s-master                      1/1     Running   10         13m
kube-apiserver-k8s-master            1/1     Running   19         13m
kube-controller-manager-k8s-master   1/1     Running   20         13m
kube-proxy-54pxj                     1/1     Running   0          13m
kube-scheduler-k8s-master            1/1     Running   20         13m
vagrant@k8s-master:~$ 
```

- What is the IP address of DNS systems ?

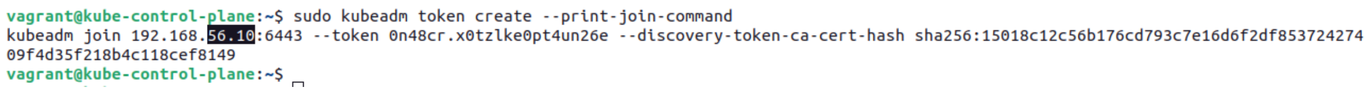


```
vagrant@kube-control-plane:~$ kubectl get pod -n kube-system -o wide
NAME                                  READY   STATUS    RESTARTS   AGE   IP              NODE                 NOMINATED NODE
S GATES
coredns-5d78c9869d-5gxxx              1/1     Running   0          19m   10.244.0.3      kube-control-plane   <none>
coredns-5d78c9869d-lfdrf              1/1     Running   0          19m   10.244.0.2      kube-control-plane   <none>
etcd-kube-control-plane               1/1     Running   0          20m   192.168.56.10   kube-control-plane   <none>
```

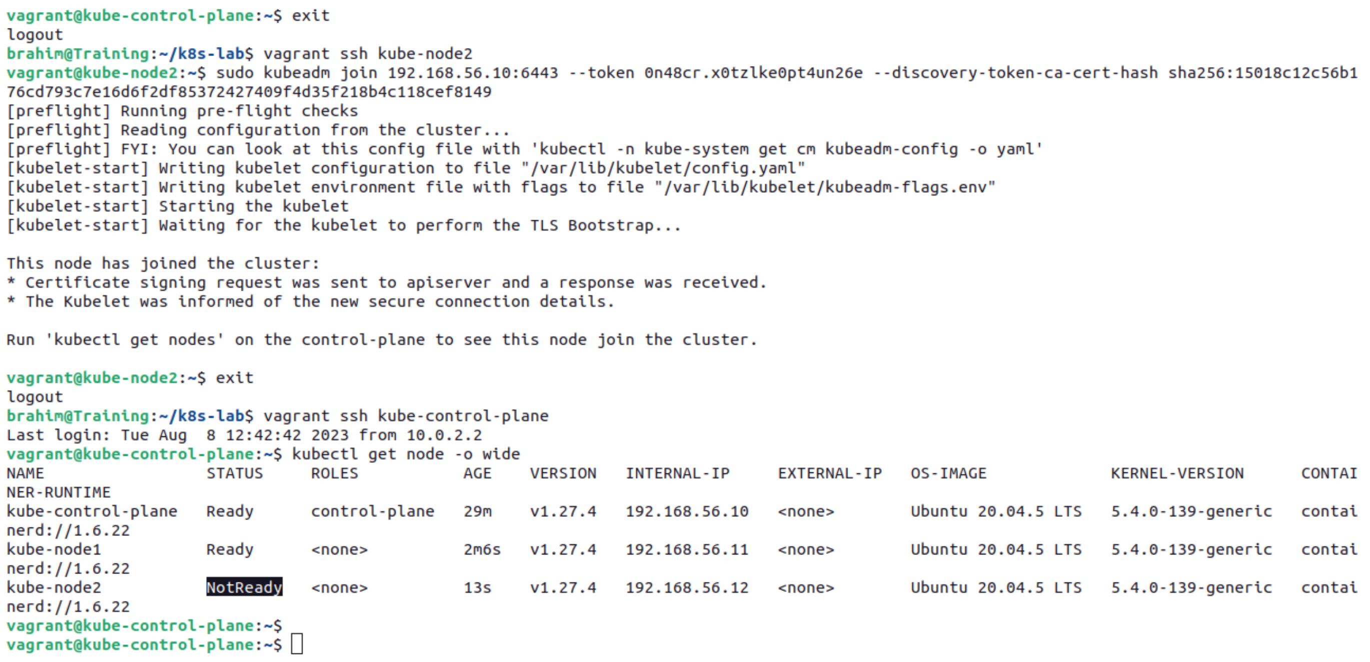
4. Join all nodes to the cluster.

- On the master, check that all nodes are ready on the cluster.

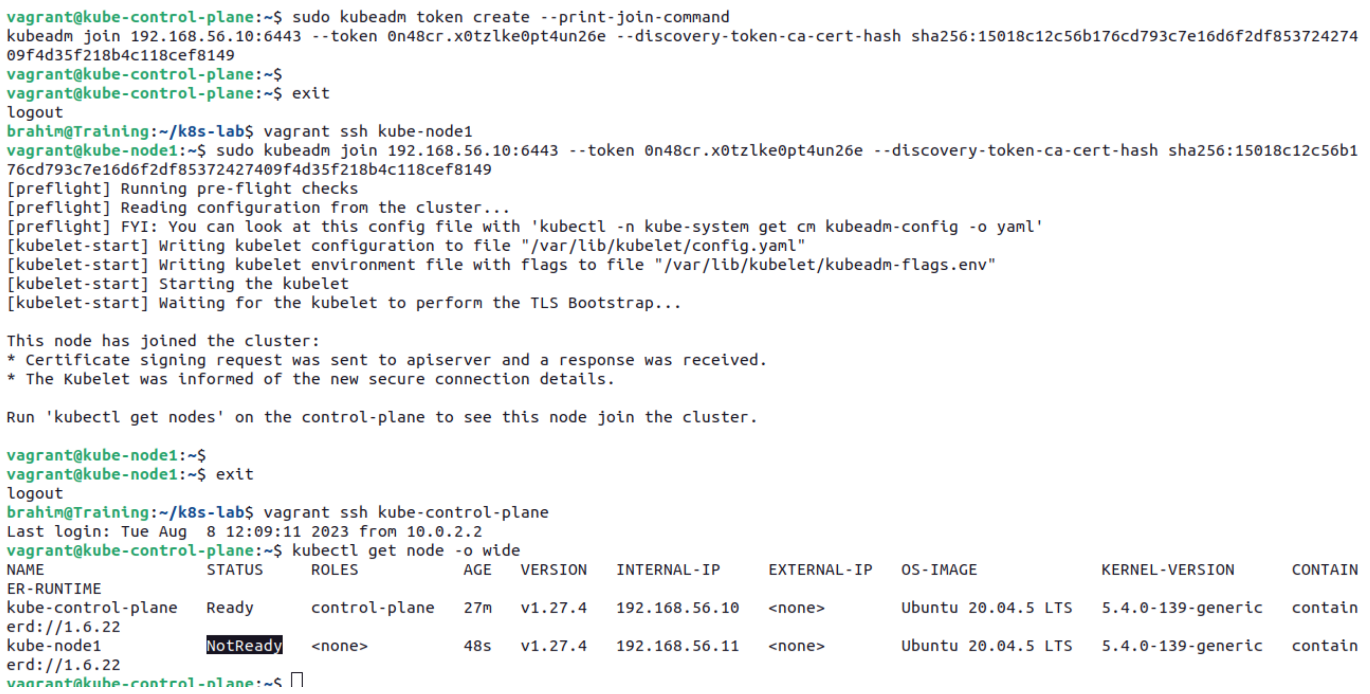
sudo kubeadm token create --print-join-command



```
vagrant@kube-control-plane:~$ sudo kubeadm token create --print-join-command
kubeadm join 192.168.56.10:6443 --token 0n48cr.x0tzlke0pt4un26e --discovery-token-ca-cert-hash sha256:15018c12c56b176cd793c7e16d6f2df853724274
09f4d35f218b4c118cef8149
vagrant@kube-control-plane:~$
```



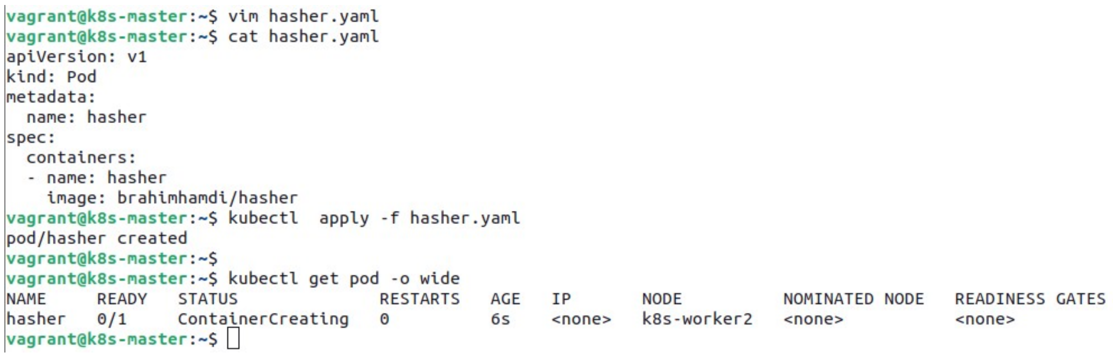
```
vagrant@kube-control-plane:~$ exit
logout
brahim@Training:~/k8s-lab$ vagrant ssh kube-node2
vagrant@kube-node2:~$ sudo kubeadm join 192.168.56.10:6443 --token 0n48cr.x0tzlke0pt4un26e --discovery-token-ca-cert-hash sha256:15018c12c56b1
76cd793c7e16d6f2df85372427409f4d35f218b4c118cef8149
[preflight] Running pre-flight checks
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-start] Waiting for the kubelet to perform the TLS Bootstrap...

This node has joined the cluster:
* Certificate signing request was sent to apiserver and a response was received.
* The Kubelet was informed of the new secure connection details.

Run 'kubectl get nodes' on the control-plane to see this node join the cluster.

vagrant@kube-node2:~$ exit
logout
brahim@Training:~/k8s-lab$ vagrant ssh kube-control-plane
Last login: Tue Aug  8 12:42:42 2023 from 10.0.2.2
vagrant@kube-control-plane:~$ kubectl get node -o wide
NAME                 STATUS     ROLES           AGE    VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION       CONTAI
NER-RUNTIME
kube-control-plane   Ready      control-plane   29m    v1.27.4   192.168.56.10   <none>        Ubuntu 20.04.5 LTS   5.4.0-139-generic    contai
nerd://1.6.22
kube-node1           Ready      <none>          2m6s   v1.27.4   192.168.56.11   <none>        Ubuntu 20.04.5 LTS   5.4.0-139-generic    contai
nerd://1.6.22
kube-node2           NotReady   <none>          13s    v1.27.4   192.168.56.12   <none>        Ubuntu 20.04.5 LTS   5.4.0-139-generic    contai
nerd://1.6.22
vagrant@kube-control-plane:~$
vagrant@kube-control-plane:~$
```



```
vagrant@kube-control-plane:~$ sudo kubeadm token create --print-join-command
kubeadm join 192.168.56.10:6443 --token 0n48cr.x0tzlke0pt4un26e --discovery-token-ca-cert-hash sha256:15018c12c56b176cd793c7e16d6f2df853724274
09f4d35f218b4c118cef8149
vagrant@kube-control-plane:~$
vagrant@kube-control-plane:~$ exit
logout
brahim@Training:~/k8s-lab$ vagrant ssh kube-node1
vagrant@kube-node1:~$ sudo kubeadm join 192.168.56.10:6443 --token 0n48cr.x0tzlke0pt4un26e --discovery-token-ca-cert-hash sha256:15018c12c56b1
76cd793c7e16d6f2df85372427409f4d35f218b4c118cef8149
[preflight] Running pre-flight checks
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-start] Waiting for the kubelet to perform the TLS Bootstrap...

This node has joined the cluster:
* Certificate signing request was sent to apiserver and a response was received.
* The Kubelet was informed of the new secure connection details.

Run 'kubectl get nodes' on the control-plane to see this node join the cluster.

vagrant@kube-node1:~$
vagrant@kube-node1:~$ exit
logout
brahim@Training:~/k8s-lab$ vagrant ssh kube-control-plane
Last login: Tue Aug  8 12:09:11 2023 from 10.0.2.2
vagrant@kube-control-plane:~$ kubectl get node -o wide
NAME                 STATUS     ROLES           AGE   VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION      CONTAIN
ER-RUNTIME
kube-control-plane   Ready      control-plane   27m   v1.27.4   192.168.56.10   <none>        Ubuntu 20.04.5 LTS   5.4.0-139-generic   contain
erd://1.6.22
kube-node1           NotReady   <none>          48s   v1.27.4   192.168.56.11   <none>        Ubuntu 20.04.5 LTS   5.4.0-139-generic   contain
erd://1.6.22
vagrant@kube-control-plane:~$
```

Manage pods

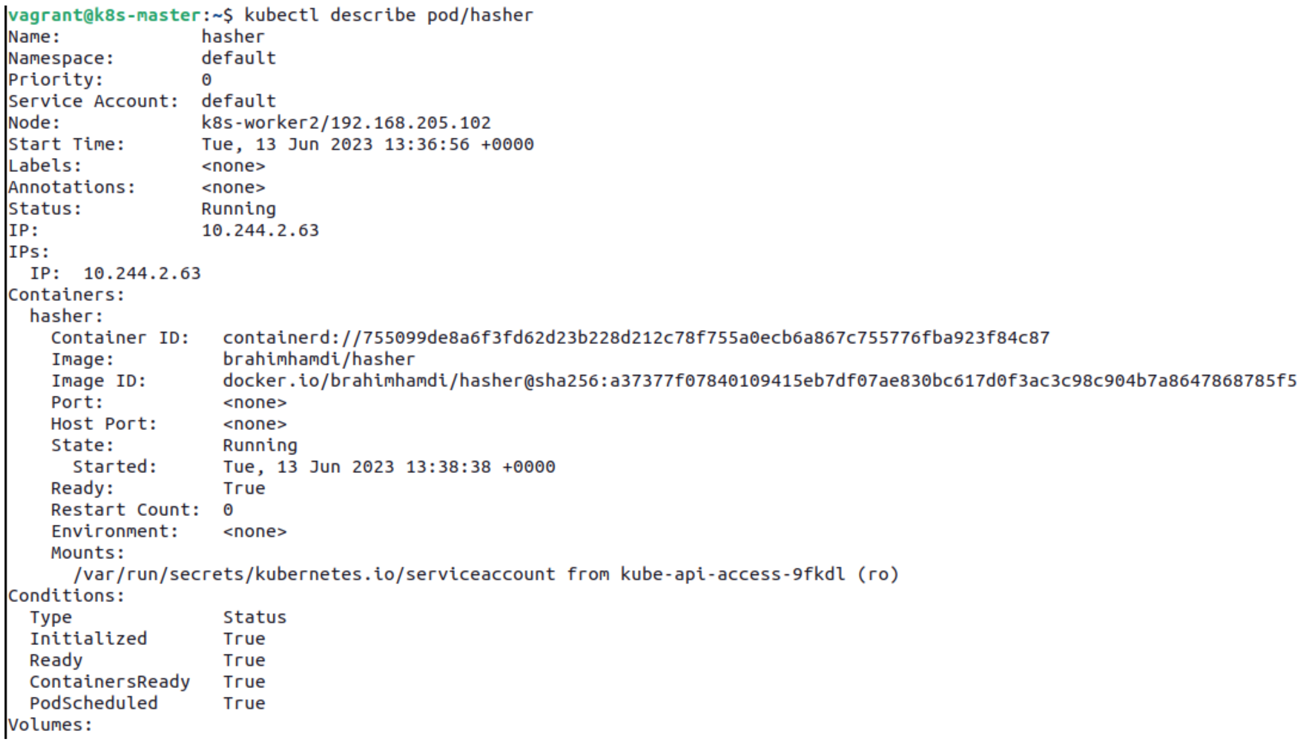
5. Create a yaml file for a *hasher* pod.



```
vagrant@k8s-master:~$ vim hasher.yaml
vagrant@k8s-master:~$ cat hasher.yaml
apiVersion: v1
kind: Pod
metadata:
  name: hasher
spec:
  containers:
  - name: hasher
    image: brahimhamdi/hasher
vagrant@k8s-master:~$ kubectl  apply -f hasher.yaml
pod/hasher created
vagrant@k8s-master:~$
vagrant@k8s-master:~$ kubectl get pod -o wide
NAME     READY   STATUS              RESTARTS   AGE   IP       NODE          NOMINATED NODE   READINESS GATES
hasher   0/1     ContainerCreating   0          6s    <none>   k8s-worker2   <none>           <none>
vagrant@k8s-master:~$
```

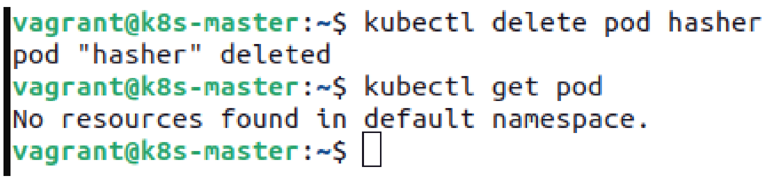
6. Apply the yaml file.

- On which node the pod is created ?
- What is the pod's IP address ?
- What is the container's name and ID ?
- What is the image's name and ID ?



```
vagrant@k8s-master:~$ kubectl describe pod/hasher
Name:             hasher
Namespace:        default
Priority:         0
Service Account:  default
Node:             k8s-worker2/192.168.205.102
Start Time:       Tue, 13 Jun 2023 13:36:56 +0000
Labels:           <none>
Annotations:      <none>
Status:           Running
IP:               10.244.2.63
IPs:
  IP:  10.244.2.63
Containers:
  hasher:
    Container ID:   containerd://755099de8a6f3fd62d23b228d212c78f755a0ecb6a867c755776fba923f84c87
    Image:          brahimhamdi/hasher
    Image ID:       docker.io/brahimhamdi/hasher@sha256:a37377f07840109415eb7df07ae830bc617d0f3ac3c98c904b7a8647868785f5
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Tue, 13 Jun 2023 13:38:38 +0000
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-9fkdl (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
```

7. Remove the pod from the cluster.



```
vagrant@k8s-master:~$ kubectl delete pod hasher
pod "hasher" deleted
vagrant@k8s-master:~$ kubectl get pod
No resources found in default namespace.
vagrant@k8s-master:~$
```

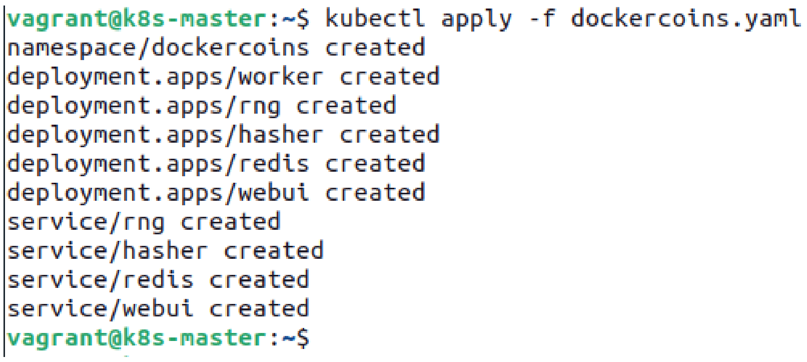
Manage deployments and services

8. Create yaml file to describe *dockercoins* application deployment.

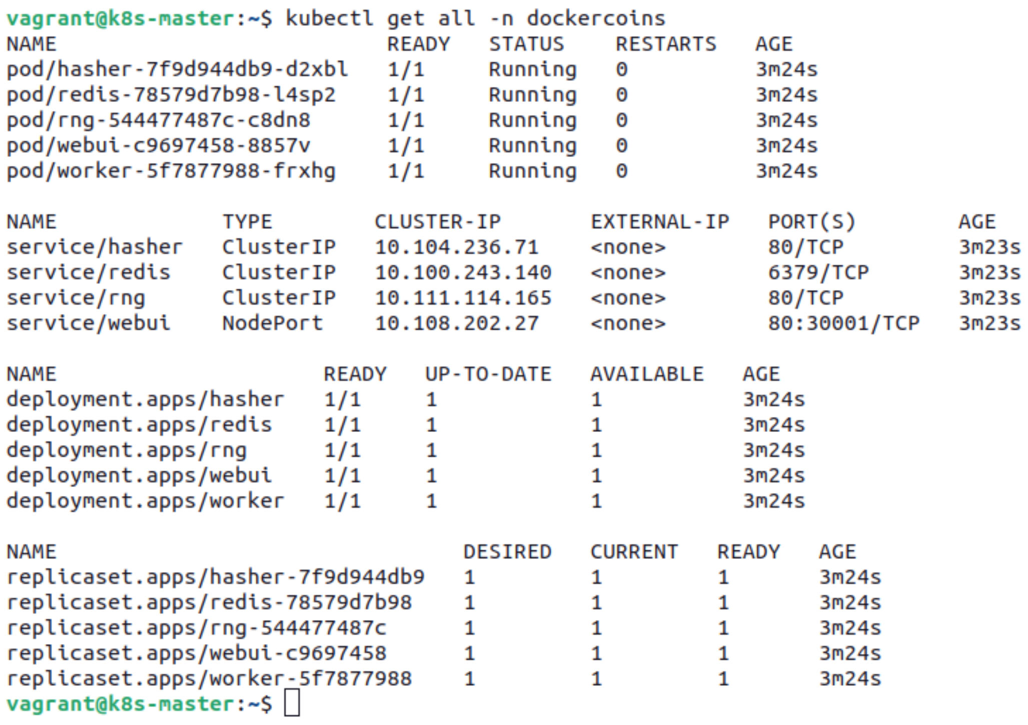
```
apiVersion: v1
kind: Namespace
metadata:
  name: dockercoins
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: worker
  namespace: dockercoins
spec:
#  replicas: 3
  selector:
    matchLabels:
      app: dockercoins
      tier: worker
  template:
    metadata:
      labels:
        app: dockercoins
        tier: worker
    spec:
      containers:
      - name: worker
        image: brahimhamdi/worker
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: rng
  namespace: dockercoins
spec:
#  replicas: 3
  selector:
    matchLabels:
      app: dockercoins
      tier: rng
  template:
    metadata:
      labels:
        app: dockercoins
        tier: rng
    spec:
      containers:
      - name: rng
        image: brahimhamdi/rng
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: hasher
  namespace: dockercoins
spec:
#  replicas: 3
  selector:
    matchLabels:
      app: dockercoins
      tier: hasher
  template:
    metadata:
      labels:
        app: dockercoins
        tier: hasher
    spec:
      containers:
      - name: hasher
        image: brahimhamdi/hasher
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: redis
  namespace: dockercoins
spec:
#  replicas: 3
  selector:
    matchLabels:
      app: dockercoins
      tier: redis
  template:
    metadata:
      labels:
        app: dockercoins
        tier: redis
    spec:
      containers:
      - name: redis
        image: redis
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webui
  namespace: dockercoins
spec:
#  replicas: 3
  selector:
    matchLabels:
      app: dockercoins
      tier: webui
  template:
    metadata:
      labels:
        app: dockercoins
        tier: webui
    spec:
      containers:
      - name: webui
```

```
        image: brahimhamdi/webui
---
apiVersion: v1
kind: Service
metadata:
  name: rng
  namespace: dockercoins
spec:
  selector:
    app: dockercoins
    tier: rng
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
  type: ClusterIP
---
apiVersion: v1
kind: Service
metadata:
  name: hasher
  namespace: dockercoins
spec:
  selector:
    app: dockercoins
    tier: hasher
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
  type: ClusterIP
---
apiVersion: v1
kind: Service
metadata:
  name: redis
  namespace: dockercoins
spec:
  selector:
    app: dockercoins
    tier: redis
  ports:
    - protocol: TCP
      port: 6379
      targetPort: 6379
  type: ClusterIP
---
apiVersion: v1
kind: Service
metadata:
  name: webui
  namespace: dockercoins
spec:
  selector:
    app: dockercoins
    tier: webui
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
      nodePort: 30001
  type: NodePort
```

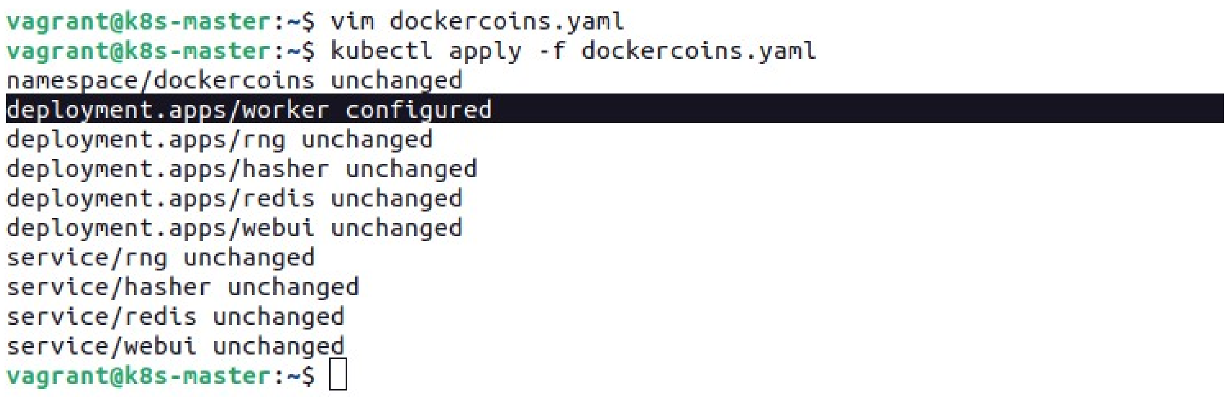
9. Apply the yaml file and check the application.



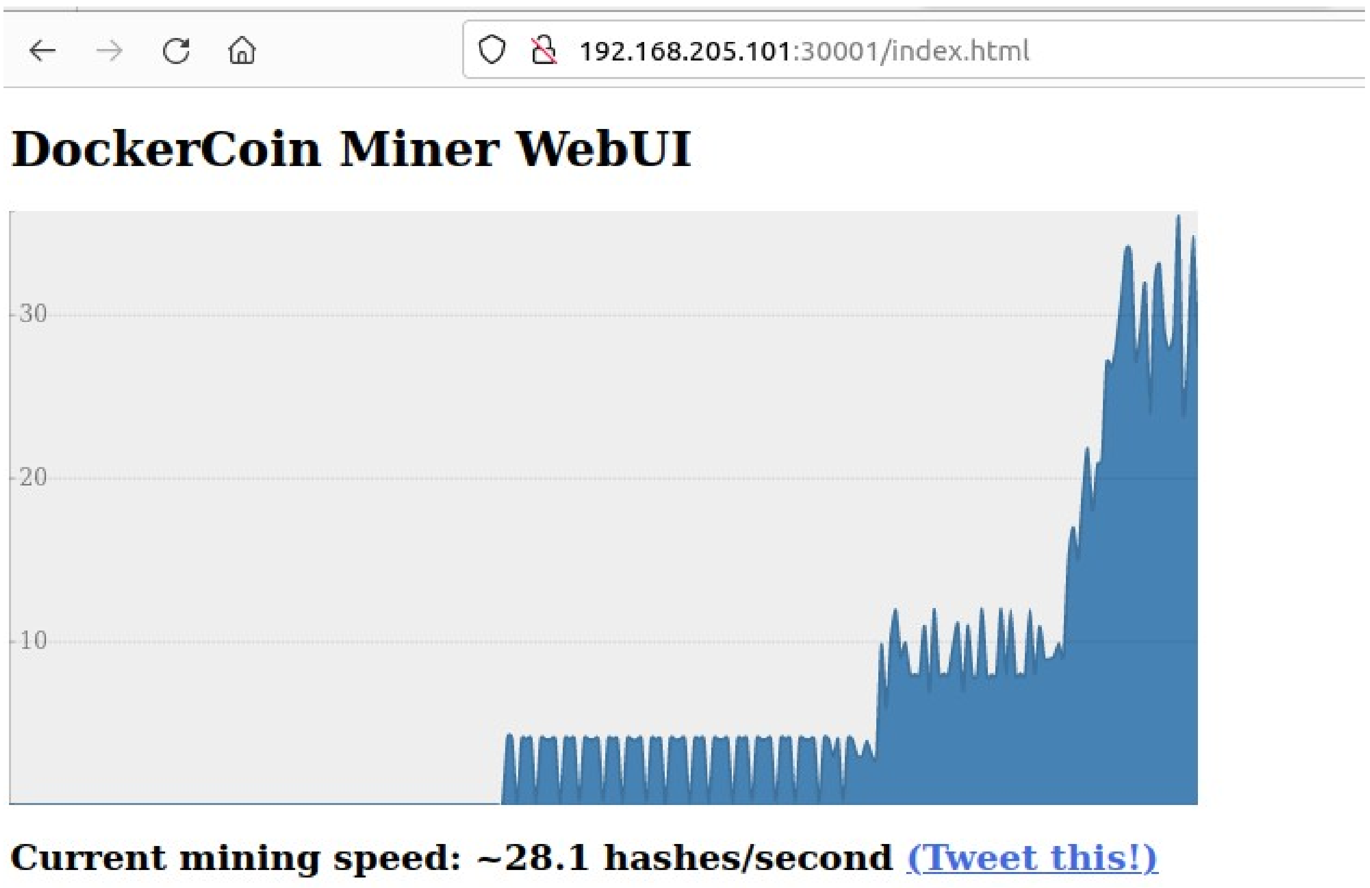
```
vagrant@k8s-master:~$ kubectl apply -f dockercoins.yaml
namespace/dockercoins created
deployment.apps/worker created
deployment.apps/rng created
deployment.apps/hasher created
deployment.apps/redis created
deployment.apps/webui created
service/rng created
service/hasher created
service/redis created
service/webui created
vagrant@k8s-master:~$
```



```
vagrant@k8s-master:~$ kubectl get all -n dockercoins
NAME                          READY   STATUS    RESTARTS   AGE
pod/hasher-7f9d944db9-d2xbl   1/1     Running   0          3m24s
pod/redis-78579d7b98-l4sp2    1/1     Running   0          3m24s
pod/rng-544477487c-c8dn8      1/1     Running   0          3m24s
pod/webui-c9697458-8857v      1/1     Running   0          3m24s
pod/worker-5f7877988-frxhg    1/1     Running   0          3m24s

NAME                TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)        AGE
service/hasher      ClusterIP   10.104.236.71    <none>        80/TCP         3m23s
service/redis       ClusterIP   10.100.243.140   <none>        6379/TCP       3m23s
service/rng         ClusterIP   10.111.114.165   <none>        80/TCP         3m23s
service/webui       NodePort    10.108.202.27    <none>        80:30001/TCP   3m23s

NAME                     READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/hasher   1/1     1            1           3m24s
deployment.apps/redis    1/1     1            1           3m24s
deployment.apps/rng      1/1     1            1           3m24s
deployment.apps/webui    1/1     1            1           3m24s
deployment.apps/worker   1/1     1            1           3m24s

NAME                                DESIRED   CURRENT   READY   AGE
replicaset.apps/hasher-7f9d944db9   1         1         1       3m24s
replicaset.apps/redis-78579d7b98    1         1         1       3m24s
replicaset.apps/rng-544477487c      1         1         1       3m24s
replicaset.apps/webui-c9697458      1         1         1       3m24s
replicaset.apps/worker-5f7877988    1         1         1       3m24s
vagrant@k8s-master:~$
```



```
vagrant@k8s-master:~$ vim dockercoins.yaml
vagrant@k8s-master:~$ kubectl apply -f dockercoins.yaml
namespace/dockercoins unchanged
deployment.apps/worker configured
deployment.apps/rng unchanged
deployment.apps/hasher unchanged
deployment.apps/redis unchanged
deployment.apps/webui unchanged
service/rng unchanged
service/hasher unchanged
service/redis unchanged
service/webui unchanged
vagrant@k8s-master:~$
```



192.168.205.101:30001/index.html

DockerCoin Miner WebUI

Current mining speed: ~28.1 hashes/second (Tweet this!)