100 XP

Exercise - Explore the functionality of a Kubernetes cluster

15 minutes

Choose your platform

Linux | Mac | Windows

Several options are available when you're running Kubernetes locally. Recall that you can install Kubernetes on physical machines or VMs, or use a cloud-based solution such as Azure Kubernetes Service (AKS).

Your goal in this exercise is to explore a Kubernetes installation and explore a single-node Kubernetes cluster. You're going to configure a MicroK8s environment that's easy to set up and tear down. Then you'll deploy an NGINX website and scale it out to multiple instances. Finally, you'll go through the steps to delete the running pods and clean up the cluster.

> **Note**
>
> This exercise is optional and includes steps that show how to delete and uninstall the software and resources you'll use in the exercise.

Keep in mind that there are other options, such as MiniKube and Kubernetes support in Docker, to do the same.

What is MicroK8s?

MicroK8s is an option for deploying a single-node Kubernetes cluster as a single package to target workstations and Internet of Things (IoT) devices. Canonical, the creator of Ubuntu Linux, originally developed and maintains MicroK8s.

You can install MicroK8s on Linux, Windows, and macOS. However, installation instructions are slightly different for each operating system. Choose the option that best fits your environment.

Install MicroK8s on Windows

You use Multipass to run MicroK8s on Windows. Multipass is a lightweight VM manager for Linux, Windows, and macOS.

1. Download and install the latest release of Multipass for Windows from GitHub.

2. In a command console, run the Multipass launch command to configure and run the microk8s-vm image. This step might take a few minutes to complete, depending on the speed of your internet connection and desktop.

   cmd Copy

   ```
   multipass launch --name microk8s-vm --mem 4G --disk 40G
   ```

3. After you receive the launch confirmation for microk8s-vm, you can access the VM instance by using the `multipass shell microk8s-vm` command.

   cmd Copy

   ```
   multipass shell microk8s-vm
   ```

   At this point, you can access the Ubuntu VM that will host your cluster and install MicroK8s.

4. Install the MicroK8s snap application. This step might take a few minutes to complete, depending on the speed of your internet connection and desktop.

   Bash Copy

   ```
   sudo snap install microk8s --classic
   ```

   A successful installation shows the following message.

   Output Copy

   ```
   ubuntu@microk8s-vm:~$ sudo snap install microk8s --classic
   2020-03-16T12:50:59+02:00 INFO Waiting for restart...
   microk8s v1.17.3 from Canonical✓ installed
   ```

You're now ready to install add-ons on the cluster.

Prepare the cluster

You can use the status command in MicroK8s to view the status of the installed add-ons on your cluster. These add-ons provide several services, some of which you covered previously.

One example is DNS functionality.

1. To check the status of the installation, run the `microk8s.status --wait-ready` command.

```
Bash
sudo microk8s.status --wait-ready
```

Notice that you can enable several add-ons on your cluster. Don't worry about the add-ons that you don't recognize. You'll enable only three of these add-ons in your cluster.

```
Output
ubuntu@microk8s-vm:~$ sudo microk8s.status --wait-ready
microk8s is running
addons:
cilium: disabled
dashboard: disabled
dns: disabled
fluentd: disabled
gpu: disabled
helm3: disabled
helm: disabled
ingress: disabled
istio: disabled
jaeger: disabled
juju: disabled
knative: disabled
kubeflow: disabled
linkerd: disabled
metallb: disabled
metrics-server: disabled
prometheus: disabled
rbac: disabled
registry: disabled
storage: disabled
```

2. Next, you'll enable the DNS, Dashboard, and Registry add-ons. Here is the purpose of each add-on.

DNS	Deploys the `coreDNS` service.
Dashboard	Deploys the `kubernetes-dashboard` service and several other services that support its functionality. It's a general-purpose, web-based UI for Kubernetes clusters.
Registry	Deploys a private registry and several services that support its functionality. You can use this registry to store private containers.

Install the add-ons by running the following command.

```
Bash
sudo microk8s.enable dns dashboard registry
```

You're now ready to access your cluster by using `kubectl`.

Explore the Kubernetes cluster

MicroK8s provides a version of `kubectl` that you can use to interact with your new Kubernetes cluster. This copy of `kubectl` allows you to have a parallel installation of another system-wide `kubectl` instance without affecting its functionality.

1. Run the `snap alias` command to alias `microk8s.kubectl` to `kubectl`. This step simplifies usage.

   ```
   Bash
   sudo snap alias microk8s.kubectl kubectl
   ```

   You'll see the following output when the command finishes successfully.

   ```
   Output
   ubuntu@microk8s-vm:~$ sudo snap alias microk8s.kubectl kubectl
   Added:
     - microk8s.kubectl as kubectl
   ```

Display cluster node information

Recall from earlier that a Kubernetes cluster exists out of master and worker nodes. Let's explore the new cluster to see what's installed.

1. Check the nodes that are running in your cluster.

   You know that MicroK8s is a single-node cluster installation, so you expect to see only one node. Keep in mind, though, that this node is both the control plane and a worker node in the cluster. Confirm this configuration by running the `kubectl get nodes` command. You can use the `kubectl get` command to retrieve information about all the resources in your cluster.

   ```
   Bash
   ```

```
sudo kubectl get nodes
```

The result will be similar to the following example, which shows you that there's only one node in the cluster with the name microk8s-vm. Notice that the node is in a ready state. The ready state indicates that the control plane might schedule workloads on this node.

Bash Copy

```
ubuntu@microk8s-vm:~$ sudo kubectl get nodes
NAME          STATUS   ROLES    AGE   VERSION
microk8s-vm   Ready    <none>   35m   v1.17.3
```

You can get more information for the specific resource that's requested. For example, let's assume that you need to find the IP address of the node. You use the `-o wide` parameter to fetch extra information from the API server.

Bash Copy

```
sudo kubectl get nodes -o wide
```

The result will be similar to the following example. Notice that you now can see the internal IP address of the node, the OS running on the node, the kernel version, and the container runtime.

Bash Copy

```
ubuntu@microk8s-vm:~$ sudo kubectl get nodes -o wide
NAME          STATUS   ROLES    AGE   VERSION   INTERNAL-IP      EXTERNAL-IP
OS-IMAGE             KERNEL-VERSION      CONTAINER-RUNTIME
microk8s-vm   Ready    <none>   36m   v1.17.3   192.168.56.132   <none>
Ubuntu 18.04.4 LTS   4.15.0-88-generic   containerd://1.2.5
```

2. The next step is to explore the services running on your cluster. As with nodes, you can use the `kubectl get` command to find information about the services running on the cluster.

Bash Copy

```
sudo kubectl get services -o wide
```

The result will be similar to the following example. But notice that only one service is listed. You installed add-ons on the cluster earlier, and you expect to see these services as well.

Bash Copy

```
ubuntu@microk8s-vm:~$ sudo kubectl get services -o wide
NAME         TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)   AGE
SELECTOR
kubernetes   ClusterIP   10.152.183.1   <none>        443/TCP   37m   <none>
```

The reason for the single service listing is that Kubernetes uses a concept called namespaces. You can use namespaces to logically divide a cluster into multiple virtual clusters.

Use the `--all-namespaces` parameter to fetch all services in all namespaces.

Bash Copy

```
sudo kubectl get services -o wide --all-namespaces
```

The result will be similar to the following example. Notice that you have three namespaces in your cluster. They're the default, `container-registry`, and `kube-system` namespaces. Here you can see the `registry`, `kube-dns`, and `kubernetes-dashboard` instances that you installed. You'll also see the supporting services that were installed alongside some of the add-ons.

Bash Copy

```
ubuntu@microk8s-vm:~$ sudo kubectl get services -o wide --all-namespaces
NAMESPACE            NAME                        TYPE        CLUSTER-IP
EXTERNAL-IP   PORT(S)                  AGE   SELECTOR
container-registry   registry                    NodePort    10.152.183.36
<none>        5000:32000/TCP           28m   app=registry
default              kubernetes                  ClusterIP   10.152.183.1
<none>        443/TCP                  37m   <none>
kube-system          dashboard-metrics-scraper   ClusterIP   10.152.183.130
<none>        8000/TCP                 28m   k8s-app=dashboard-metrics-
scraper
kube-system          heapster                    ClusterIP   10.152.183.115
<none>        80/TCP                   28m   k8s-app=heapster
kube-system          kube-dns                    ClusterIP   10.152.183.10
<none>        53/UDP,53/TCP,9153/TCP   28m   k8s-app=kube-dns
kube-system          kubernetes-dashboard        ClusterIP   10.152.183.132
<none>        443/TCP                  28m   k8s-app=kubernetes-dashboard
kube-system          monitoring-grafana          ClusterIP   10.152.183.88
<none>        80/TCP                   28m   k8s-app=influxGrafana
kube-system          monitoring-influxdb         ClusterIP   10.152.183.232
<none>        8083/TCP,8086/TCP        28m   k8s-app=influxGrafana
```

Now that you can see the services running on the cluster, you can schedule a workload on the worker node.

Install a web server on a cluster

You want to schedule a web server on the cluster to serve a website to your customers. You can choose from several options. For this example, you'll use NGINX.

Recall from earlier that you can use pod manifest files to describe your pods, replica sets, and deployments to define workloads. Because you haven't covered these files in detail, you'll use `kubectl` to directly pass the information to the API server.

Even though the use of `kubectl` is handy, using manifest files is a best practice. Manifest files allow you to roll forward or roll back deployments with ease in your cluster. These files also help document the configuration of a cluster.

1. Use the `kubectl create deployment` command to create your NGINX deployment. Specify the name of the deployment and the container image to create a single instance of the pod.

   Bash Copy

   ```
   sudo kubectl create deployment nginx --image=nginx
   ```

   The result will be similar to the following example.

   Bash Copy

   ```
   ubuntu@microk8s-vm:~$ sudo kubectl create deployment nginx --image=nginx
   deployment.apps/nginx created
   ```

2. Use `kubectl get deployments` to fetch the information about your deployment.

   Bash Copy

   ```
   ubuntu@microk8s-vm:~$ sudo kubectl get deployments
   ```

   The result will be similar to the following example. Notice that the name of the deployment matches the name you gave it, and that one deployment with this name is in a ready state and available.

   Bash Copy

   ```
   ubuntu@microk8s-vm:~$ sudo kubectl get deployments
   NAME    READY   UP-TO-DATE   AVAILABLE   AGE
   nginx   1/1     1            1           18s
   ```

3. The deployment created a pod. Use the `kubectl get pods` command to fetch info about your cluster's pods.

```
Bash
ubuntu@microk8s-vm:~$ sudo kubectl get pods
```

The result will be similar to the following example. Notice that the name of the pod is a generated value prefixed with the name of the deployment, and the pod has a status of running.

```
Bash
ubuntu@microk8s-vm:~$ sudo kubectl get pods
NAME                     READY   STATUS    RESTARTS   AGE
nginx-86c57db685-dj6lz   1/1     Running   0          33s
ubuntu@microk8s-vm:~$
```

Test the website installation

Test the NGINX installation by connecting to the web server through the pod's IP address.

1. Use the `-o wide` parameter to find the address of the pod.

```
Bash
ubuntu@microk8s-vm:~$ sudo kubectl get pods -o wide
```

The result will be similar to the following example. Notice that the command returns both the IP address of the node and the node name on which the workload is scheduled.

```
Bash
ubuntu@microk8s-vm:~$ sudo kubectl get pods -o wide
NAME                     READY   STATUS    RESTARTS   AGE     IP
NODE          NOMINATED NODE   READINESS GATES
nginx-86c57db685-dj6lz   1/1     Running   0          4m17s   10.1.83.10
microk8s-vm   <none>           <none>
```

2. Use `wget` to access the website.

```
Bash
wget 10.1.83.10
```

The result will be similar to the following example.

```
ubuntu@microk8s-vm:~$ wget 10.1.83.10
--2020-03-16 13:34:17--  http://10.1.83.10/
Connecting to 10.1.83.10:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 612 [text/html]
Saving to: 'index.html'

index.html                                          100%
[=============================================================================
==================>]     612  --.-KB/s    in 0s

2020-03-16 13:34:17 (150 MB/s) - 'index.html' saved [612/612]
```

Scale a web server deployment on a cluster

Assume that you suddenly see an increase in users who access your website, and the website starts failing because of the load. You can deploy more instances of the site in your cluster and split the load across the instances.

You can use the `kubectl scale` command to scale the number of replicas in your deployment. You specify the number of replicas you need and the name of the deployment.

1. Run the `kubectl scale` command to scale the total of NGINX pods to three.

```
sudo kubectl scale --replicas=3 deployments/nginx
```

The result will be similar to the following example.

```
ubuntu@microk8s-vm:~$ sudo kubectl scale --replicas=3 deployments/nginx
deployment.apps/nginx scaled
```

The scale command allows you to scale the instance count up or down.

2. Check the number of running pods by using the `kubectl get` command, and again pass the `-o wide` parameter.

```
ubuntu@microk8s-vm:~$ sudo kubectl get pods -o wide
```

The result will be similar to the following example. Notice that you now see three running pods, each with a unique IP address.

```
Bash
ubuntu@microk8s-vm:~$ sudo kubectl get pods -o wide
NAME                     READY   STATUS    RESTARTS   AGE     IP
NODE          NOMINATED NODE   READINESS GATES
nginx-86c57db685-dj6lz   1/1     Running   0          7m57s   10.1.83.10
microk8s-vm   <none>           <none>
nginx-86c57db685-lzrwp   1/1     Running   0          9s      10.1.83.12
microk8s-vm   <none>           <none>
nginx-86c57db685-m7vdd   1/1     Running   0          9s      10.1.83.11
microk8s-vm   <none>           <none>
ubuntu@microk8s-vm:~$
```

You would need to apply several additional configurations to the cluster to effectively expose your website as a public-facing website. Examples include installing a load balancer and mapping node IP addresses. This type of configuration forms part of advanced aspects that you'll explore in the future.

Uninstall MicroK8s

You can remove everything you've deployed so far, and even the VM, to recover space on your development machine. Keep in mind that this procedure is optional.

1. Remove the add-ons from the cluster by running the `microk8s.disable` command and specifying the add-ons to remove.

```
Bash
sudo microk8s.disable dashboard dns registry
```

2. Remove MicroK8s from the VM by running the `snap remove` command.

```
Bash
sudo snap remove microk8s
```

3. Exit the VM by running the `exit` command.

```
Bash
exit
```

4. Stop the VM by running the `multipass stop` command and specifying the VM's name.

```
Bash
multipass stop microk8s-vm
```

5. Delete and purge the VM instance by running `multipass delete` and then `multipass purge`.

```
cmd
multipass delete microk8s-vm
multipass purge
```

Next unit: When to use Kubernetes

Continue >