Deploy a Web Application Using a Kubernetes Deployment and Service

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Introduction

This guide is designed to help users set up and deploy web applications in a local Kubernetes environment using Minikube on a Windows system. Minikube is an open-source tool that runs a single-node Kubernetes cluster on your local machine, providing an easy-to-use environment for Kubernetes learning, development, and testing.

By following this guide, you will learn:

- How to set up a Kubernetes cluster locally using Minikube.
- How to deploy web applications using Kubernetes Deployment and manage their lifecycle.
- How to expose your web applications to internal or external traffic using Kubernetes Service.

Problem Statement

In this lab, we will deploy an NGINX-based web application on a local Kubernetes cluster using **Minikube**. We will create a Kubernetes Deployment to manage the application's lifecycle and a Service to expose it.

Prerequisites

Completion of all previous lab guides (up to Lab Guide-01) is required before proceeding with Lab Guide-02.

- Minikube is running on your Windows system.
- `kubectl` is installed and configured to interact with your Minikube cluster.

Setup Instructions

Step 1: Create a Deployment for NGINX

We will start by deploying NGINX using a Kubernetes Deployment. The Deployment ensures that NGINX is running in a stable state with three replicas.

1. **Create the YAML for Deployment**

Create a new file called `nginx-deployment.yaml` in your working directory with the following content:

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
spec:
  replicas: 3
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:latest
        ports:
        - containerPort: 80
```

Key points:

- **replicas**: 3 instances of NGINX will be deployed.
- **image**: NGINX is pulled from the official Docker image (`nginx:latest`).
- **ports**: Exposes port 80 inside the container.

2. **Deploy NGINX to Kubernetes**

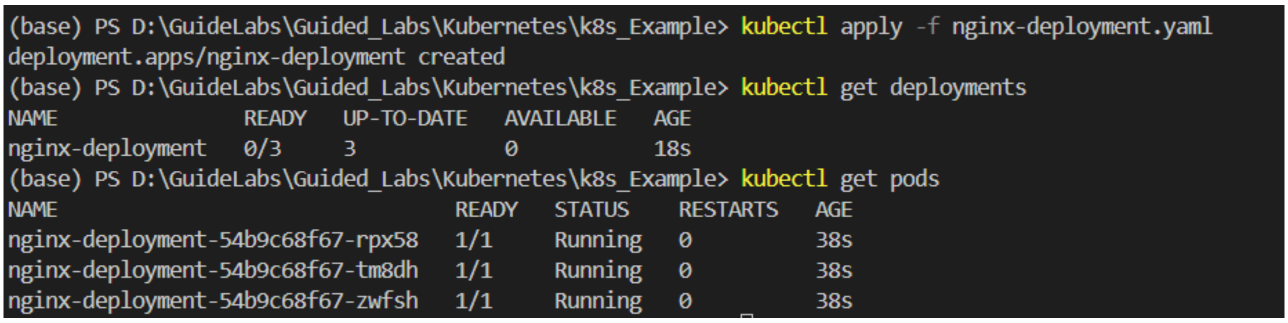
   Apply the `nginx-deployment.yaml` file by running the following command:

```
kubectl apply -f nginx-deployment.yaml
```

3. **Verify the Deployment**

   Check the status of the deployment and ensure the pods are running:

```
kubectl get deployments
kubectl get pods
```



```
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl apply -f nginx-deployment.yaml
deployment.apps/nginx-deployment created
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl get deployments
NAME               READY   UP-TO-DATE   AVAILABLE   AGE
nginx-deployment   0/3     3            0           18s
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-54b9c68f67-rpx58   1/1     Running   0          38s
nginx-deployment-54b9c68f67-tm8dh   1/1     Running   0          38s
nginx-deployment-54b9c68f67-zwfsh   1/1     Running   0          38s
```

You should see three pods running for the `nginx-deployment`.

Step 2: Create a Service to Expose NGINX

Next, we will create a Service to expose the NGINX application inside the cluster. A **ClusterIP** service will be used to make the application accessible to other pods within the cluster.

1. **Create the YAML for Service**

   Create a new file called `nginx-service.yaml` with the following content:

   ```
   apiVersion: v1
   kind: Service
   metadata:
     name: nginx-service
   spec:
     type: ClusterIP
     selector:
       app: nginx
     ports:
     - port: 80
       targetPort: 80
   ```

   Key points:

   - **type: ClusterIP**: Exposes the service within the cluster (internal access).
   - **selector**: Targets the pods labeled with `app: nginx`.
   - **ports**: Exposes port 80 both internally and in the container.

2. **Deploy the Service**

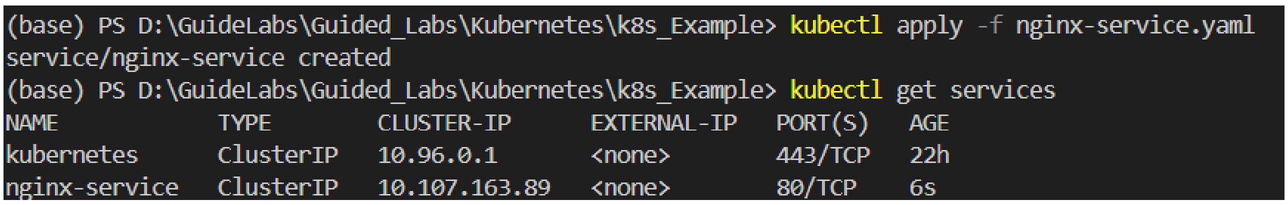
   Apply the `nginx-service.yaml` by running the following command:

   ```
   kubectl apply -f nginx-service.yaml
   ```

3. **Verify the Service**

   Check the service status and ensure it's running:

```
kubectl get services
```



```
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl apply -f nginx-service.yaml
service/nginx-service created
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl get services
NAME            TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)   AGE
kubernetes      ClusterIP   10.96.0.1       <none>        443/TCP   22h
nginx-service   ClusterIP   10.107.163.89   <none>        80/TCP    6s
```

You should see the `nginx-service` listed.

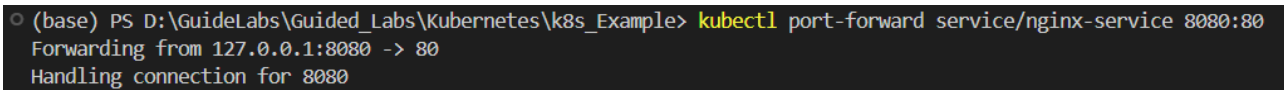
Step 3: Accessing the NGINX Application

Since this service is internal to the cluster, you can use `kubectl` to forward the local port to access NGINX from your browser.

1. **Port-forward the Service**

   Run the following command to forward a local port (e.g., 8080) to the NGINX pod:

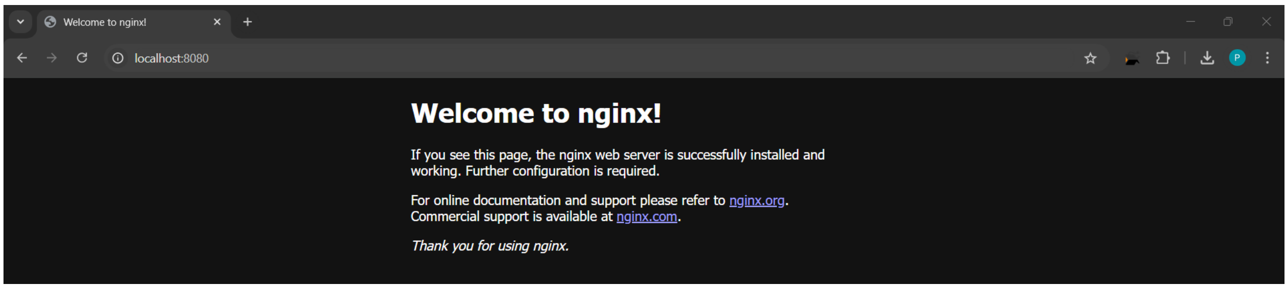
   ```
   kubectl port-forward service/nginx-service 8080:80
   ```



```
(base) PS D:\GuideLabs\Guided_Labs\Kubernetes\k8s_Example> kubectl port-forward service/nginx-service 8080:80
Forwarding from 127.0.0.1:8080 -> 80
Handling connection for 8080
```

2. **Open NGINX in Your Browser**

   Open your browser and navigate to `http://localhost:8080`. You should see the default NGINX welcome page.



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.

References

- Kubernetes Deployment Documentation
- Kubernetes Service Documentation
