Les octets aléatoires d'Adnan

Programmation, productivité, entrepreneuriat et astuces de vie

Déployez votre première application Web PHP/MySQL évolutive dans Kubernetes

Introduction

Dans cet article, je vais parler de Kubernetes, de ce que c'est, pourquoi l'utiliser et comment l'utiliser. À la fin de cet article, vous devriez être en mesure de comprendre le fonctionnement de base de Kubernetes et de pouvoir déployer votre application dans un cluster Kubernetes.

Condition préalable

Il sera très difficile de comprendre Kubernete vous n'avez aucune idée d'un outil de conteneurisation comme Docker. Si vous ne savez pas ce qu'est Docker et comment l'utiliser pour créer une architecture modulaire, vous devriez consulter cette série en deux parties. (Partie 1 , Partie 2). En fait, je vous recommande de lire les deux parties car cet article est la suite de *la série Docker* et utilisera le même code et les mêmes images dans ce tutoriel.

Arrière-plan

Docker est un excellent outil pour diviser votre application en plusieurs composants et les exécuter comme une seule application. Jusqu'ici tout va bien, mais supposons que votre application ou une application Web devienne assez célèbre et obtienne autant de visites, comment y feriez-vous face ? Vous diriez, eh bien, ajouter plus de conteneurs ? bien ! c'est ce qui sera fait, mais comment allez-vous répartir le trafic, que ferez-vous si l'un des conteneurs meurt, comment le gérerez-vous ? Serez-vous toujours debout pour vous en occuper ? Et si vous voulez envoyer la version 2 de votre célèbre application ? Vous pourriez dire, eh bien, je descendrais mes conteneurs et les téléchargerais rapidement, ou je préparerais un conteneur de sauvegarde et dès que le nouveau conteneur serait mis en ligne, je pointerais rapidement mon application vers cette IP. Tout est possible mais pas faisable et faisable. Surtout si votre application est très célèbre, vous ne voudriez pas faire face à des temps d'arrêt de celle-ci. Kubernetes est la réponse à tout cela, et

probablement à de nombreuses autres questi

liées au déploiement automatisé et évolutif.

Qu'est-ce que Kubernetes ?

Crédit d'image

Depuis le site officiel :

> *Kubernetes (k8s) est un système open source permettant d'automatiser le déploiement, la mise à l'échelle et la gestion des applications conteneurisées.*
>
> *Il regroupe les conteneurs qui composent une application en unités logiques pour une gestion et une découverte faciles.*

Vous avez une idée. Les K8 offrent un moyen de regrouper des conteneurs existants ou nouveaux et de les faire fonctionner comme une seule entité logique, facilitant ainsi l'automatisation d'opérations telles que le déploiement et la mise à l'échelle.

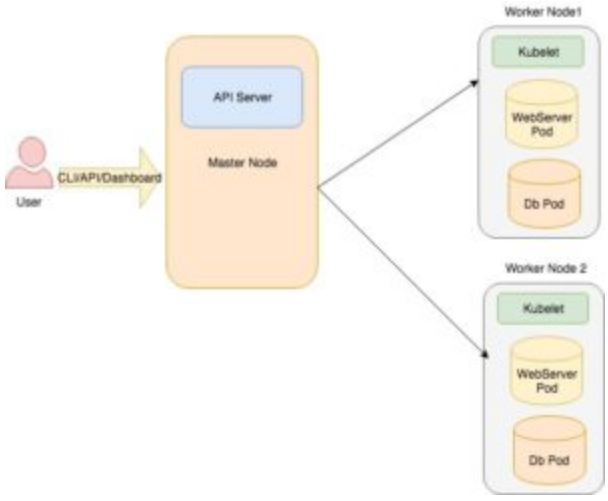
En d'autres termes, les K8 offrent un moyen d'orchestrer vos conteneurs.

Kubernetes est principalement utilisé dans applications basées sur les microservices.

Qu'est-ce que l'orchestration de conteneurs ?

Container orchestration is about managing life cycles of containers. In modern application development, a single application is divided into multiple units that are usually installed in containers. Container orchestration helps to run these individual units as a single app. Orchestration helps in provisioning and deployment of containers, resource allocation, load balancing and many other things. Just to tell that Kubernetes is NOT the only way to orchestrate containers, Apache Mesos and Docker Swarms are alternate options available.

Kubernetes Architecture



Master Node

The master node consists of 3 components:

1. **API Server**:- A REST API based server that allows the Administrator to perform several operations like Pods creation, deployment etc.
2. **Scheduler:-** The purpose of the scheduler to take care nodes management. It is responsible where to divert the traffic to a worker node or how to use resources properly by making sure that required resources are available.
3. **Controller Manager:-** It is responsible to manage different kinds of controllers offered by Kubernetes. ***Node Controller*** is responsible to notify when a node goes down. ***Replication Controller*** makes sure that the correct number of pods are available. ***Endpoints Controller*** populates the endpoint objects for Pods and Services. ***Service Account & Token Controllers*** are responsible for creating accounts and tokens for accessing different parts of the system

Worker Node

A worker node is a machine(VM/Physical) which runs applications by using Pods and is controlled by the master node. A worker node consists of the following components:

1. **Kubelet:-** It is the lowest level component in Kubernetes which is responsible to figure out what to run on a single machine/node. It is kind of a supervisor of containers and makes sure that the required number of containers/pods are running at any given time.
2. **Pod:-** A pod is a collection of containers that share the same resources. A pod encapsulates containers, network IP and storage resources. It is the single instance of an application which is deployed. Usually, a pod contains a single

container but it is not restricted to it. instance, a Database server pod contains a container for the Db itself and another container for storing logging data. It is not mandatory to use Docker containers, others like rkt is also used.

3. **Service:-** Pods are born and died, you can't trust them to be with you in rainy days. Therefore, there was a need for something that works as a proxy of underlying pods and provides you an interface for communication irrespective of which pod is alive and which pod is going to die. Services have the option to provide an external IP so that the outer world can communicate. For instance, you could have a web service to access the containerized Apache and show the page on your favorite browser. Labels are used to pick the required set of pods. For instance, pods labeled with **app-frontend** will be picked by a service which uses the **app-frontend** *Label Selector*.

OK, too much text, it's time to take action and get our hands dirty.

Installation and Configuration

Kubernetes is provided by many Cloud Providers like Google Cloud Platform(GCP), Azure by Microsoft and EKS by Amazon. Thankfully, you don't need to use any of these services when starting as Kubernetes provides Minikube, a single cluster based environment for local development and testing. You don't have to worry about which cloud platform you will be using lately as all are using K8s anyway. Think of it running your PHP web app in XAMPP or MAMP and you just upload

on a remote apache server without making changes in your coding file. In order to run Minikube, you should have following tools installed on your machine:

- **VirtualBox or VMWare**. I am using Virtualbox so go for it. You can download it from here.
- **kubectl**: It is used to access the Kubernetes cluster. You can download it from here as per your OS requirements. Since I am on OSX so will go for the homebrew version.

```
brew install kubernetes-cli
```

If installed correctly then `kubectl version` should give you the following output:

```
➜  LearningK8s kubectl version
Client    Version:    version.Info{Major:"1",
Minor:"13",             GitVersion:"v1.13.1",
GitCommit:"eec55b9ba98609a46fee712359c7b5b365bdd
GitTreeState:"clean",     BuildDate:"2019-01-
01T08:17:16Z",          GoVersion:"go1.11.4",
Compiler:"gc", Platform:"darwin/amd64"}
Server    Version:    version.Info{Major:"",
Minor:"",               GitVersion:"v1.9.0",
GitCommit:"925c127ec6b946659ad0fd596fa959be43f0c
GitTreeState:"clean",     BuildDate:"2018-01-
26T19:04:38Z",          GoVersion:"go1.9.1",
Compiler:"gc", Platform:"linux/amd64"}
```

Next, install Minikube. Though latest versions greater than 0.30 are now available but I will go with the **version 0.25**.0 as Minikube versions > 0.26 giving issues on start so better go with the one which is stable.

```
curl -Lo minikube
https://storage.googleapis.com/minikube/releases
linux-amd64 && chmod +x minikube && sudo mv
minikube /usr/local/bin/
```

It will download the file via CURL, make it executable and then move to the folder which is in PATH. If installed well then you should see something like below:

```
➜ LearningK8s minikube version
minikube version: v0.25.0
```

You can also check the status by running `minikube status`

```
➜ LearningK8s minikube status
minikube: Running
cluster: Running
kubectl: Correctly Configured: pointing to
minikube-vm at 192.168.99.100
```

Needless to say but all of the commands above should be run on the terminal/console.

Importing Local images into Kubernetes

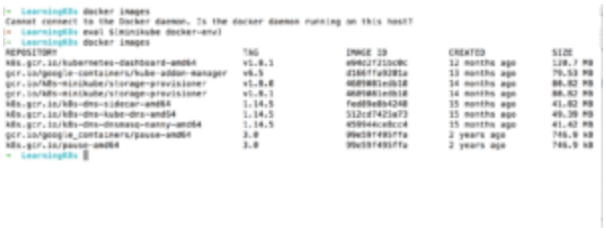
We already have prepared configuration files for our required PHP and MySQL Images in the posts related to docker. So I created a new folder and transferred the existing `Dockerfile` and `docker-compose.yaml` in it. The goal is to create images for K8s. How to make images INSIDE a Kubernetes

cluster? Not a big deal. When you install miniku you also get a pre-installed docker. You can test it by doing an SSH to minikube.

Good but how to prepare images locally and transfer to minikube's docker. Luckily provide a way to do it.

```
eval $(minikube docker-env)
```

When you run the above command on your terminal it lets you interact with the docker system WITHIN the cluster:

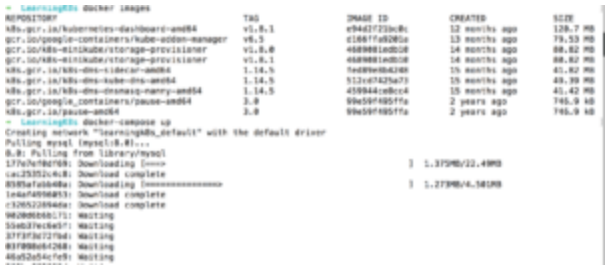


You can undo or getting out of minikube docker by running the command:

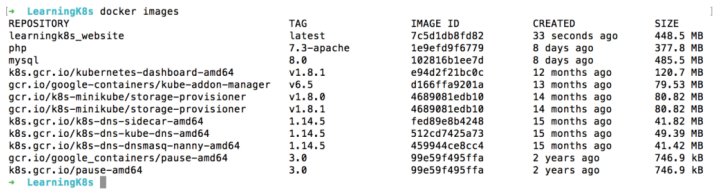
```
eval $(minikube docker-env -u)
```

I already transferred the existing `Dockerfile` and `docker-compose.yaml` file in the folder, all I have to do is to runt he `docker-compose up` command. Before you ask, let me clarify that you don't have to go for this route. All you need is to BUILD your images which can easily be done by running `docker build` command. Since I am lazy enough, I am

using same compose file to create the requi images.



It will take a while to download. Once done you can see something similar:

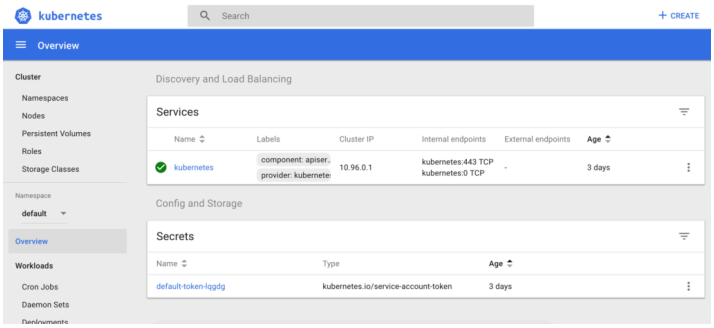


```
→  LearningK8s docker images
REPOSITORY                                  TAG                 IMAGE ID            CREATED             SIZE
learningk8s_website                         latest              7c5d1db8fd82        33 seconds ago      448.5 MB
php                                         7.3-apache          1e9efd9f6779        8 days ago          377.8 MB
mysql                                       8.0                 102816b1ee7d        8 days ago          485.5 MB
k8s.gcr.io/kubernetes-dashboard-amd64       v1.8.1              e94d2f21bc0c        12 months ago       120.7 MB
gcr.io/google-containers/kube-addon-manager v6.5                d166ffa9201a        13 months ago       79.53 MB
gcr.io/k8s-minikube/storage-provisioner     v1.8.0              4689081edb10        14 months ago       80.82 MB
gcr.io/k8s-minikube/storage-provisioner     v1.8.1              4689081edb10        14 months ago       80.82 MB
k8s.gcr.io/k8s-dns-sidecar-amd64            1.14.5              fed89e8b4248        15 months ago       41.82 MB
k8s.gcr.io/k8s-dns-kube-dns-amd64           1.14.5              512cd7425a73        15 months ago       49.39 MB
k8s.gcr.io/k8s-dns-dnsmasq-nanny-amd64      1.14.5              459944ce8cc4        15 months ago       41.42 MB
gcr.io/google_containers/pause-amd64        3.0                 99e59f495ffa        2 years ago         746.9 kB
k8s.gcr.io/pause-amd64                      3.0                 99e59f495ffa        2 years ago         746.9 kB
→  LearningK8s
```

As you can see, the images, **learningk8s_website, PHP and MySQL** are now available.

Accessing Minikube

I will be using both CLI and GUI based tools to administer the cluster. For CLI you can just use `kubectl` and for GUI base you can launch the web interface by running the command `minikube dashboard`



The required Images are ready. It's to cre
deployments so that your apps can run inside pods.

What is Deployment?

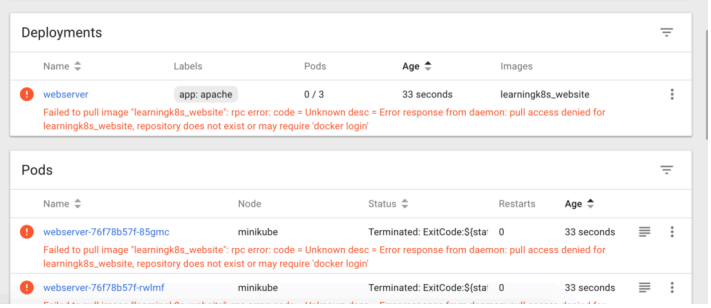
A deployment object keeps the info how pods will be created and how will they run and communicate with each other. A DeploymentController makes sure that the desired containers state is equal to the current running state. In short, it is all about how your apps will be deployed and run within containers who themselves are part of pods. We will create two deployments; one for the web server and other for MySQL DB. First we will create `webserver.yaml` file.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webserver
  labels:
    app: apache
spec:
  replicas: 3
  selector:
    matchLabels:
      app: apache
  template:
    metadata:
      labels:
        app: apache
    spec:
      containers:
      - name: php-apache
        image: learningk8s_website
        imagePullPolicy: Never
```

```
    ports:
    - containerPort: 80
```

Many things are similar to Docker related file. `labels` as I told earlier, is used to select relevant pods. Since pods are mortal and new could be created, labels are used to pick relevant pods. In our case it is `app: apache`. The `selectors` is then used to pick the pods to match labels. Learn more about them here.

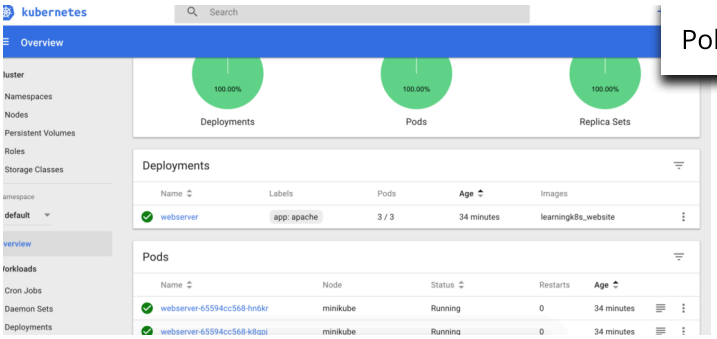
We then set `replicas: 3`. It means that a web server will have 3 instances. In the `containers` section I added `imagePullPolicy` to `Never`. The reason I had to do is that if you don't do it, it tries to pull the image from main DockerHub website and if does not found, it gives error like below:



Since I already have prepared the image locally hence I am going to use it.

The deployment file is ready, I am going to run the following command to deploy it:

```
kubectl create -f webserver.yaml
```



As you can see, 3 pods are now created for the deployment `webserver`.

You can also run `kubectl get pods` in the terminal to get the response:

```
➜  LearningK8s kubectl get pods
NAME                                READY   STATUS
RESTARTS   AGE
webserver-65594cc568-hn6kr   1/1     Running
0          43m
webserver-65594cc568-k8gpj   1/1     Running
0          43m
webserver-65594cc568-vvr4s   1/1     Running
0          43m
```

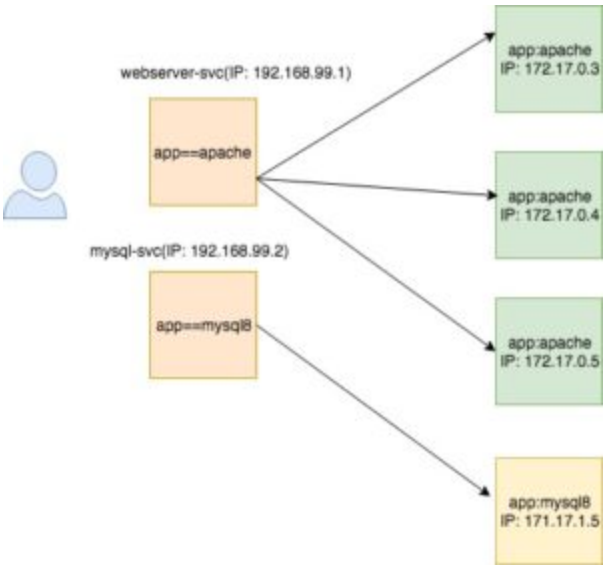
If you are on the dashboard, clicking on a single pod gives you more details:

`kubectl describe pod webserver-65594cc568-hn6kr` and it returns:

Alright, the pod is created but we can't access it despite having its IP, the reason because the Pod IP is not public, more, the life of pod is uncertain so even if we know the IP it's useless to use it in our app. So is there any solution? Yes, there it is and it's called ***service***.

Kubernetes Service

A ***service*** is responsible to make possible accessing multiple pods in a way that the end-user does not know which application instance is being used. When a user tries to access an app, for instance, a web server here, it actually makes a request to a service which itself then check where it should forward the request.



Makes sense, No? Now in order to access the webserver you will just access the IP and port as

deifned in the service configuration file.


```
apiVersion: v1
kind: Service
metadata:
  name: web-service
  labels:
    run: web-service
spec:
  type: LoadBalancer
  ports:
  - port: 80
    protocol: TCP
  selector:
    app: apache
```

Here the `type` is selected to `LoadBalancer` because we want the service to decide the best pod to serve the request. By doing this you are automatically scaling your app from one server to the multiple web servers to deal with high traffic. How awesome is that! We will use the same `kubectl create -f webserver-svc.yaml` command. The `create` command knows which kind of obect to be created by reading `kind` attribute. You coud have a single file for both deployment and service seperated by `--`

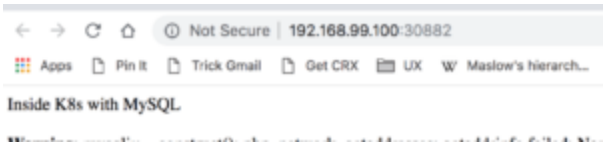
Once the service is created, you can see it in the dashboard as well as via CLI. Running `a` will give you the following result:

```
➜  LearningK8s kubectl get svc
NAME             TYPE              CLUSTER-IP
EXTERNAL-IP   PORT(S)        AGE
kubernetes       ClusterIP          10.96.0.1
```

```
<none>          443/TCP          3d9h
web-service     LoadBalancer     10.103.182.115
<pending>       80:30882/TCP     5m33s
```

Don't worry about `<pending>` thing. It is because we are using Loadbalancer and since we are on minikube instead of some Cloud Provider, it will remain pending. In case if you run on Google Cloud or Azure you will get an IP for it.

Now, the service is ready, it's time to check whether the webserver is running. There are two ways to run it. First, run `minikube service list` and it will return you the IP along with the port. The other way is `minikube service web-service` which again will open the same URL. If all goes well you should see this page:



Same method of creating deployment and service for MySQLDB but this time only a single instnace of MySQLDB will be used.

```
apiVersion: apps/v1 # for versions before
1.9.0 use apps/v1beta2
kind: Deployment
metadata:
  name: mysql
spec:
  selector:
    matchLabels:
      app: mysql8
  strategy:
```

```
    type: Recreate
  template:
    metadata:
      labels:
        app: mysql8
    spec:
      containers:
      - image: mysql:8.0
        name: mysql
        imagePullPolicy: Never
        env:
        - name: MYSQL_ROOT_PASSWORD
          value: .sweetpwd.
        - name: MYSQL_DATABASE
          value: my_db
        - name: MYSQL_USER
          value: db_user
        - name: MYSQL_PASSWORD
          value: .mypwd
           args: ["--default-authentication-
plugin=mysql_native_password"]
        ports:
        - containerPort: 3306
          name: mysql8
```

Just like we did in docker, here we pass the mysql8 related arguments as `args` and environment variables also passed in. Now, let's create the relevant service.

```
apiVersion: v1
kind: Service
metadata:
  name: mysql8-service
  labels:
    app: mysql8
spec:
  type: NodePort
```

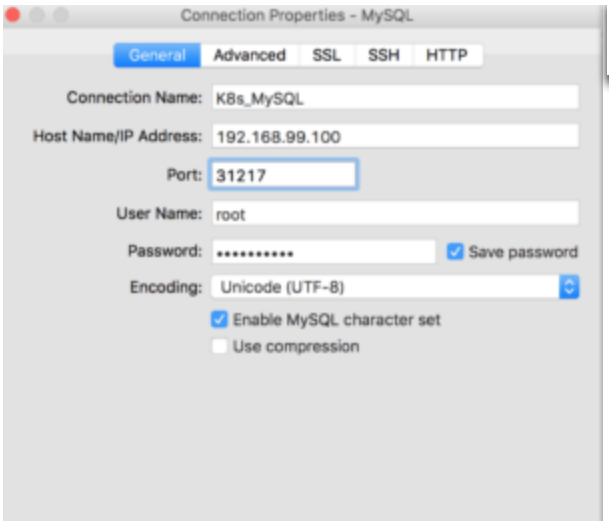
```
  ports:
  - port: 3306
    protocol: TCP
  selector:
    app: mysql8
```

Here I set the the `type` to `NodePort` because I want to connect my favorite MySQL client with the DB inside the cluster. I can do it with `LoadBalancer` as well but since we are using a single DB server so `NodePort` is good enough to do our work.

Alright, the MySQL service is created by running `kubectl create -f mysql-svc.yaml` which we can witness on the dashboard.

```
➜  LearningK8s minikube service list
|-------------|----------------------|------
----------------------|
|   NAMESPACE   |            NAME            |
URL             |
|-------------|----------------------|------
----------------------|
| default      | kubernetes             | No
node port               |
| default       | mysql8-service          |
http://192.168.99.100:31217 |
| default       | web-service             |
http://192.168.99.100:30882 |
| kube-system | kube-dns                | No
node port               |
|   kube-system   |   kubernetes-dashboard   |
http://192.168.99.100:30000 |
|-------------|----------------------|------
----------------------|
```

You can connect your local MySQL client.



Now I make the required connection string changes in the code:

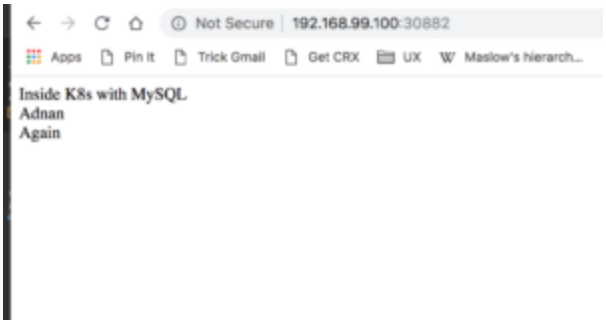
```
<?php
echo "Inside K8s with MySQL <br>";
$conn = new mysqli("mysql8-service", "root",
".sweetpwd.", "my_db");
// Check connection
if ($conn->connect_error) {
        die("Connection failed: " . $conn-
>connect_error);
}

$sql = "SELECT name FROM users";
$result = $conn->query($sql);

if ($result->num_rows > 0) {
        // output data of each row
        while($row = $result->fetch_assoc())
{
                echo $row['name']."<br>";
        }
} else {
        echo "0 results";
```

```
}
$conn->close();
```


Like Docker here I passed the service name instead of the actual IP because both IP/Port could change and service name here will resolve the actual address. If everything goes fine then this screen should made your day.



OK, you did almost your job, only two things left. Right now If you make changes in code, it will not reflect. Also, if you remove MySQL deployment or even restart minikube it will also erase the data. What is required is mounting volume.

So, for making changes in the code we have to first mount local folder in Minikube and then mount *minikube* folder to the cluster. For that, we have to stop minikube and start with the following parameters.

```
minikube start --mount-string /Development/PetProjects/LearningK8s/src:/data --mount
```

I passed the local path with `--mount-string` which is then mapped to `/data` inside minikube. In the end, I passed the `--mount` parameter.

You can see that the `index.php` exists in `data` folder. This is 50% done, we still have to push things to the machines within containers. For that I will make changes in the Deployment so that the spec will now look like:

```
spec:
      containers:
      - name: php-apache
        image: learningk8s_website
        imagePullPolicy: Never
        ports:
        - containerPort: 80
        volumeMounts:
        - name: hostvol
          mountPath: /var/www/html/
      volumes:
        - name: hostvol
          hostPath:
            path: /data
```

I created a volume with name `hostvol` and then mount it to the **DocumentRoot** of Apache. I made changes and then ran the following command to update the existing deployment.

```
kubectl apply -f webserver.yaml
```

Now if you make changes in code it would ref
instantly as if you are working on local machine.

So far so good, now all is left to retain MySQL data. In order to do it, we need `PersistentVolumeClaim`

Persistent Volume Claim configuration allocates space so that future MySQL data can be stored independent of a pod's life.

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: mysql-pv-claim
  labels:
    app: mysql8
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 5Gi #5 GB
```

Here `ReadWriteOnce` access mode is set which means that only a single node can mount it in **RW** mode. In a real scenario you might have to set `ReadWriteMany`. Create the claim by running `kubectl create -f mysql-pv-claim.yaml` and then update the ***MySQL deployment. Don't forget to create the claim first* otherwise *you would have* mounting *issue.***

```
spec:
      containers:
      - image: mysql:8.0
        name: mysql
```

```
          imagePullPolicy: Never
          env:
          - name: MYSQL_ROOT_PASSWORD
            value: .sweetpwd.
          - name: MYSQL_DATABASE
            value: my_db
          - name: MYSQL_USER
            value: db_user
          - name: MYSQL_PASSWORD
            value: .mypwd
             args: ["--default-authentication-
plugin=mysql_native_password"]
          ports:
          - containerPort: 3306
            name: mysql8
          volumeMounts:
            - name: mysql-persistent-storage
              mountPath: /var/lib/mysql
        volumes:
        - name: mysql-persistent-storage
          persistentVolumeClaim:
            claimName: mysql-pv-claim
```

I set the `persistentVolumeClaim` to the one created by us and also mount to default path of `mysql` server. Update the MySQL file as did for the web server by running `kubectl apply -f mysql.yaml`

Go ahead and delete the MySQL related pod or even restart minikube, your data will remain intact.

If you are done with your work then run `eval $(minikube docker-env -u)` to detact the Docker inside K8s.

Conclusion

So in this post you learn how to install & configure Kubernetes locally and deploy your first web application. I have just touched the surface of the K8s, it is more than what is covered here. Especially the ***Rolling Update*** feature is amazing to deploy upgraded apps in a way it does not go down for a moment. I will see if I can cover in future posts. For now, that's it with the DevOps series.

As always code is avaiable on Github.

DevOps docker kubernetes

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