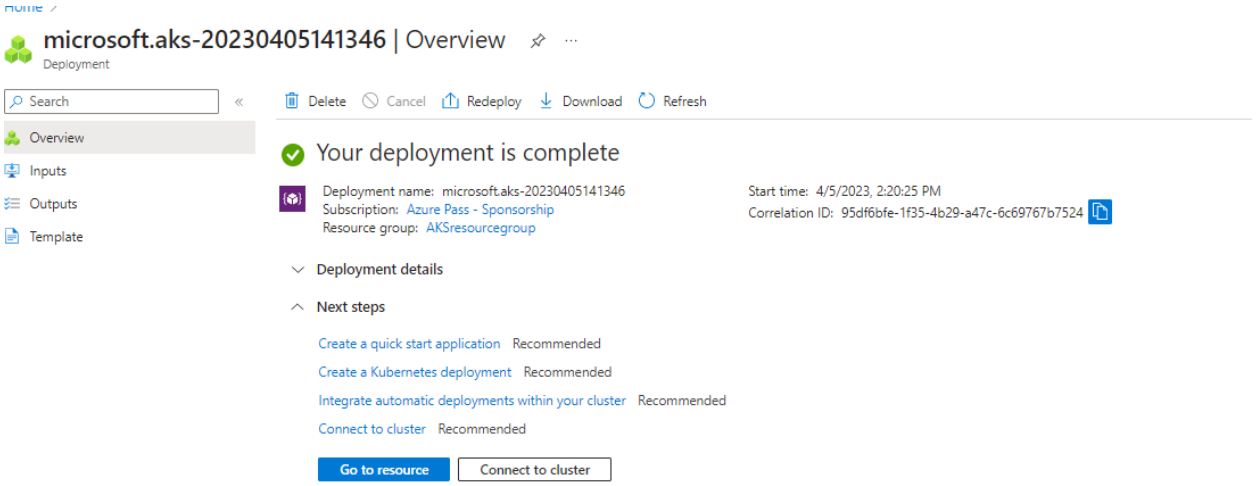
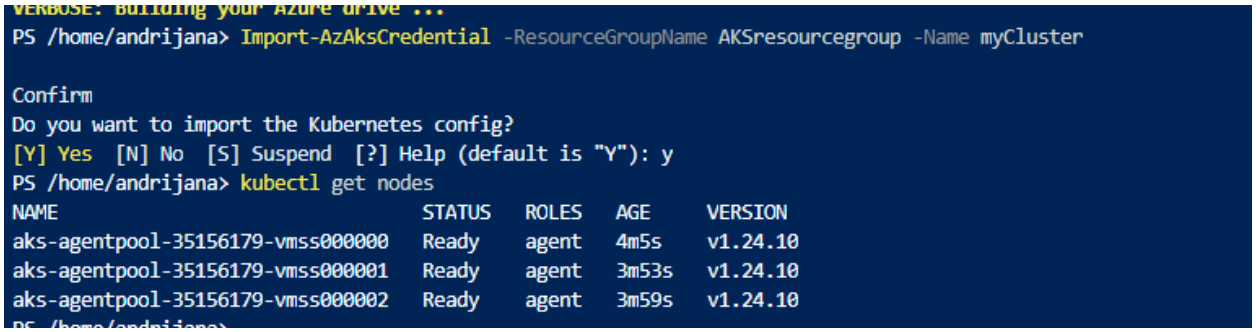
Kubernetes Pods Lab

Practice1: Simple pods operations Note: Try not to do a copy/paste on commands requests unless you are instructed to do so. Copy/paste will not help you to learn Kubernetes!

1. Login to Azure and connect to your AKS cluster.



- First, we need to create a Kubernetes cluster and connect to it via the PowerShell built-in plugin on Azure or Azure CLI. I chose the first option.



- I've logged in with the credentials of the resourceGroup name and the name of the cluster

2. Check how many pods run under the default namespace. Run ***kubectl get pods***.

```
PS /home/andrijana> kubectl get pods
No resources found in default namespace.
```

- No pods are found in the default namespace, and this is expected behavior since we haven't deployed any.

3. You should not see any pod under the default namespace. Now check all namespaces. Run ***kubectl get pods –all-namespace***.

```
PS /home/andrijana> kubectl get pods --all-namespaces
NAMESPACE     NAME                                  READY   STATUS    RESTARTS   AGE
kube-system   ama-logs-b2n8k                        2/2     Running   0          7m22s
kube-system   ama-logs-hdf7r                        2/2     Running   0          7m28s
kube-system   ama-logs-rs-7df6dd884-xkx94           1/1     Running   0          7m41s
kube-system   ama-logs-xrcwf                        2/2     Running   0          7m16s
kube-system   azure-ip-masq-agent-hkrtz             1/1     Running   0          7m28s
kube-system   azure-ip-masq-agent-j9ncm             1/1     Running   0          7m16s
kube-system   azure-ip-masq-agent-qg6rz             1/1     Running   0          7m22s
kube-system   cloud-node-manager-6jq4d              1/1     Running   0          7m16s
kube-system   cloud-node-manager-bqggv              1/1     Running   0          7m22s
kube-system   cloud-node-manager-jrhsm              1/1     Running   0          7m28s
kube-system   coredns-59b6bf8b4f-ntrz8              1/1     Running   0          7m40s
kube-system   coredns-59b6bf8b4f-zq2tr              1/1     Running   0          6m20s
kube-system   coredns-autoscaler-5f9cb57949-clzcb   1/1     Running   0          7m40s
kube-system   csi-azuredisk-node-4xtx5              3/3     Running   0          7m16s
kube-system   csi-azuredisk-node-v2zsv              3/3     Running   0          7m28s
kube-system   csi-azuredisk-node-wqshs              3/3     Running   0          7m22s
kube-system   csi-azurefile-node-bjllv              3/3     Running   0          7m16s
kube-system   csi-azurefile-node-g4v4s              3/3     Running   0          7m22s
kube-system   csi-azurefile-node-md5dx              3/3     Running   0          7m28s
kube-system   konnectivity-agent-c88dd5cff-t6hsb    1/1     Running   0          7m40s
kube-system   konnectivity-agent-c88dd5cff-x9hj7    1/1     Running   0          7m40s
kube-system   kube-proxy-5xqzd                      1/1     Running   0          7m16s
kube-system   kube-proxy-h2nn2                      1/1     Running   0          7m22s
kube-system   kube-proxy-hzk5n                      1/1     Running   0          7m28s
kube-system   metrics-server-5f8d84558d-2nnzd       2/2     Running   0          6m18s
kube-system   metrics-server-5f8d84558d-kqx6s       2/2     Running   0          6m18s
PS /home/andrijana>
```

4. How many pods do you see? Who deployed these pods? Why are they deployed?
   - I can see 26 pods, deployed by the Azure Kubernetes Service automatically.

5. Now deploy you first pod using the imperative approach. Run ***kubectl run nginx --image=nginx***.

```
PS /home/andrijana> kubectl run nginx --image=nginx
pod/nginx created
```

6. Validate if the pods has been created. What is the status of your pod?

```
PS /home/andrijana> kubectl describe pods
Name:             nginx
Namespace:        default
Priority:         0
Service Account:  default
Node:             aks-agentpool-35156179-vmss000000/10.224.0.6
Start Time:       Wed, 05 Apr 2023 12:33:48 +0000
Labels:           run=nginx
Annotations:      <none>
Status:           Running
IP:               10.244.0.13
IPs:
  IP:  10.244.0.13
```

- The pod **has been created** and the status of the pod is **Running**

```
  Normal  Started    23s   kubelet            Started container nginx
PS /home/andrijana> kubectl describe pods nginx
Name:             nginx
Namespace:        default
Priority:         0
Service Account:  default
Node:             aks-agentpool-35156179-vmss000000/10.224.0.6
Start Time:       Wed, 05 Apr 2023 12:33:48 +0000
Labels:           run=nginx
Annotations:      <none>
Status:           Running
IP:               10.244.0.13
IPs:
  IP:  10.244.0.13
Containers:
  nginx:
    Container ID:   containerd://5807fdfcebfe6f70680754414ae192849eb5725589cef7b729be20d62d2499fe
    Image:          nginx
    Image ID:       docker.io/library/nginx@sha256:2ab30d6ac53580a6db8b657abf0f68d75360ff5cc1670a85acb5bd85ba1b19c0
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Wed, 05 Apr 2023 12:33:51 +0000
    Ready:          True
    Restart Count:  0
    Environment:    <none>
```

- I can also use the command kubectl describe pods nginx to get the same result

7. Check the logs coming out of your pod. Run kubectl logs nginx.

```
PS /home/andrijana> kubectl logs nginx
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2023/04/05 12:33:51 [notice] 1#1: using the "epoll" event method
2023/04/05 12:33:51 [notice] 1#1: nginx/1.23.4
2023/04/05 12:33:51 [notice] 1#1: built by gcc 10.2.1 20210110 (Debian 10.2.1-6)
2023/04/05 12:33:51 [notice] 1#1: OS: Linux 5.4.0-1104-azure
2023/04/05 12:33:51 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2023/04/05 12:33:51 [notice] 1#1: start worker processes
2023/04/05 12:33:51 [notice] 1#1: start worker process 29
2023/04/05 12:33:51 [notice] 1#1: start worker process 30
PS /home/andrijana>
```

8. Run the following command to check the current resource consumption of your pod: kubectl top pod nginx.

```
PS /home/andrijana> kubectl top pod nginx
NAME    CPU(cores)   MEMORY(bytes)
nginx   0m           3Mi
```

9. Check on which Node your pods have been scheduled. Run kubectl get pods –o wide.

```
NAME    READY   STATUS    RESTARTS   AGE     IP           NODE                                NOMINATED NODE   READINESS GATES
nginx   1/1     Running   0          4m27s   10.244.0.13  aks-agentpool-35156179-vmss000000   <none>           <none>
```

- The pod is scheduled on the **aks-agentpool-35156179-vmss000000** node

10. Try to find the same information but this time running kubectl describe pod nginx.

```
PS /home/andrijana> kubectl describe pod nginx
Name:             nginx
Namespace:        default
Priority:         0
Service Account:  default
Node:             aks-agentpool-35156179-vmss000000/10.224.0.6
```

- The last one is the name of the Node

11. Delete your pod using kubectl delete pod nginx.

```
PS /home/andrijana> kubectl delete pod nginx
pod "nginx" deleted
```

12. Let's find the image used on one of the coredns pods under the kube-system namespace.

```
Container ID:   containerd://4a66b5c789c6bba79c315ee5e18814b66654aec54181c65afb567b7e3a9876
Image:          mcr.microsoft.com/oss/kubernetes/coredns:v1.9.3
Image ID:       sha256:c38f956b642366c8eeb0babfda6b0bb2aa92f27a968589804cadb445f6df72d6
```

13. Once again list all pods under all namespaces.

```
PS /home/andrijana> kubectl get pods --all-namespaces
NAMESPACE     NAME                                  READY   STATUS    RESTARTS   AGE
kube-system   ama-logs-hdf7r                        2/2     Running   0          18m
kube-system   ama-logs-rs-7df6dd884-xkx94           1/1     Running   0          18m
kube-system   azure-ip-masq-agent-hkrtz             1/1     Running   0          17m
kube-system   cloud-node-manager-jrhsm              1/1     Running   0          17m
kube-system   coredns-59b6bf8b4f-ntrz8              1/1     Running   0          18m
kube-system   coredns-59b6bf8b4f-zq2tr              1/1     Running   0          16m
kube-system   coredns-autoscaler-5f9cb57949-clzcb   1/1     Running   0          18m
kube-system   csi-azuredisk-node-v2zsv              3/3     Running   0          17m
kube-system   csi-azurefile-node-md5dx              3/3     Running   0          17m
kube-system   konnectivity-agent-c88dd5cff-t6hsb    1/1     Running   0          18m
kube-system   konnectivity-agent-c88dd5cff-x9hj7    1/1     Running   0          18m
kube-system   kube-proxy-hzk5n                      1/1     Running   0          17m
kube-system   metrics-server-7dd74d8758-pxdqp       2/2     Running   0          4m40s
kube-system   metrics-server-7dd74d8758-v5xwq       2/2     Running   0          4m41s
```

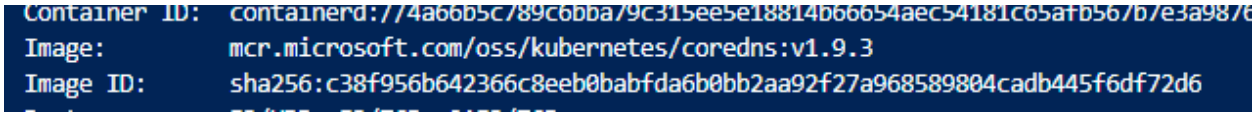
Terminal container button

14. Note one of the coredns pods. Now run **kubectl describe pod <coredns-name> -n kube-system**. Replace the place holder with noted name.

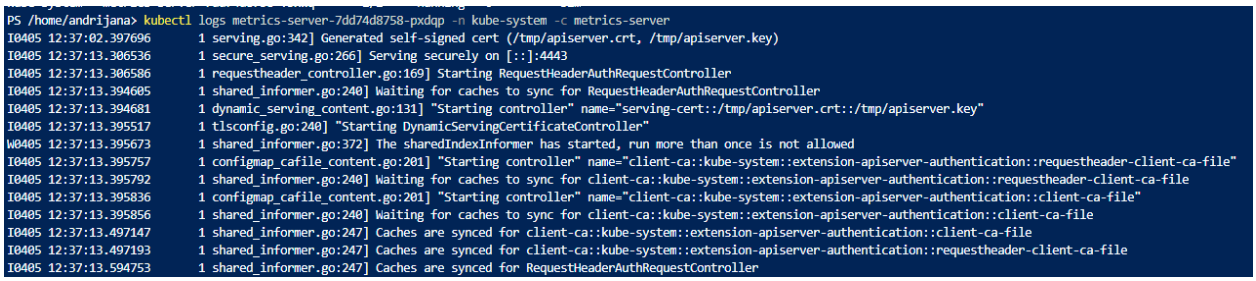
```
PS /home/andrijana> kubectl describe pod coredns-59b6bf8b4f-ntrz8 -n kube-system
Name:                 coredns-59b6bf8b4f-ntrz8
Namespace:            kube-system
Priority:             2000001000
Priority Class Name:  system-node-critical
Service Account:      coredns
Node:                 aks-agentpool-35156179-vmss000000/10.224.0.6
Start Time:           Wed, 05 Apr 2023 12:24:30 +0000
Labels:               k8s-app=kube-dns
                      kubernetes.io/cluster-service=true
                      pod-template-hash=59b6bf8b4f
                      version=v20
Annotations:          prometheus.io/port: 9153
Status:               Running
IP:                   10.244.0.8
IPs:
  IP:           10.244.0.8
Controlled By:  ReplicaSet/coredns-59b6bf8b4f
Containers:
```

- Inspecting the pod with name **coredns-59b6bf8b4f-ntrz8**

15. Inspect the output and locate the image information.



16. Now let us check the logs of the metrics-server pod. Run the same command as in step 7 but don't forget to add the namespace in which this pod is created.



- kubectl logs metrics-server-7dd74d8758-pxdqp -n kube-system -c metrics-server

This command will print the logs of the metrics-server pod under the name 7dd74d8758-pxdqp, created in the kube-system namespace

-n flag -> pod namespace
-c flag -> container name

Practice2: Working with pod manifest files

1. Now it is time to deploy pod using manifest file (declarative approach). Copy the following code block on your local computer in a file called redis.yaml:

```
apiVersion: v11
kind: pod
metadata:
name: static-web
labels:
role: myrole
specs:
containers:
 - name: redis
```

```
image: redis123
```

- I copied this code in Visual Studio yaml file and saved it locally.

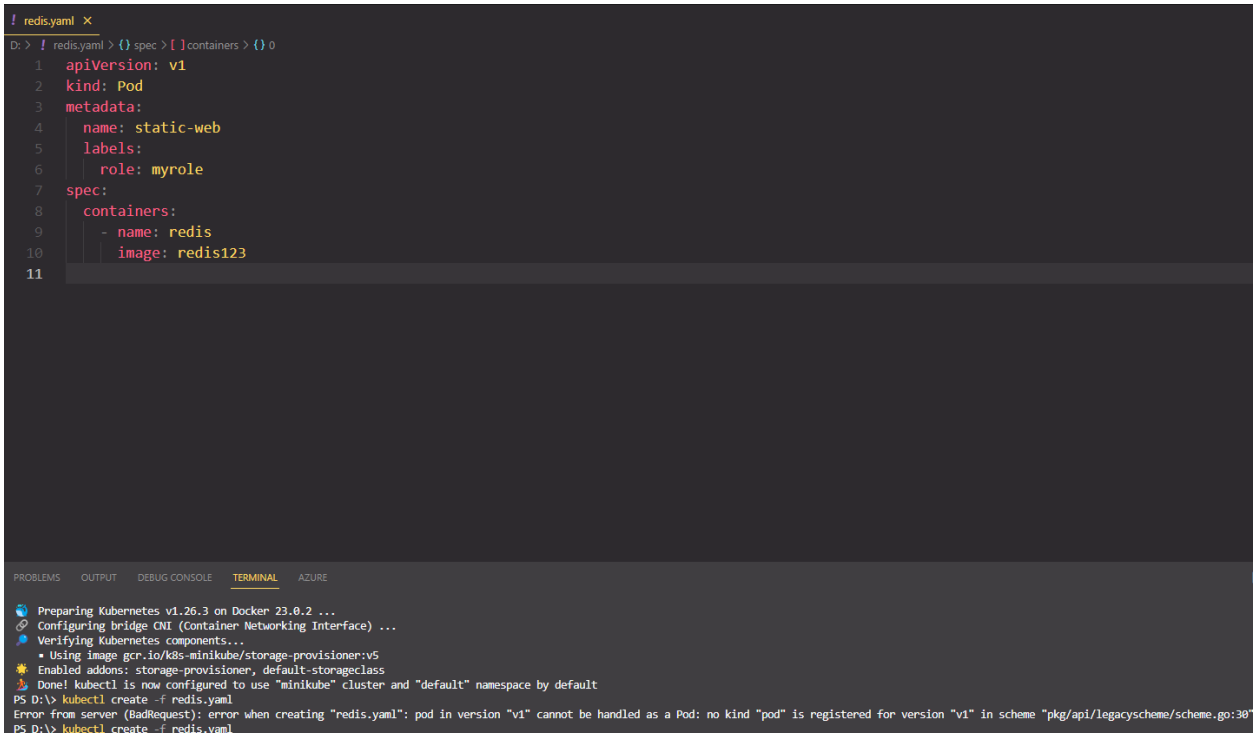
2. Try to deploy the pod defined in redis.yaml. Run kubectl create –f redis.yaml.

```
PS D:\> kubectl create -f redis.yaml
Error from server (BadRequest): error when creating "redis.yaml": pod in version "v1" cannot be handled as a Pod: no kind "pod" is registered for version "v1" in scheme "pkg/api/legacyscheme/scheme.go:30"
```

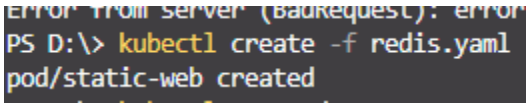
3. You will receive errors on your screen. Your next task will be to correct the syntax of the code you just copied. You can use the online Kubernetes documentation or you can search the internet in general.


```
PS D:\> kubectl create -f redis.yaml
Error from server (BadRequest): error when creating "redis.yaml": pod in version "v1" cannot be handled as a Pod: no kind "pod" is registered for version "v1" in scheme "pkg/api/legacyscheme/scheme.go:30"
```


- I was getting an error that pod cannot be handled as Pod, and it has to start with the capital letter P.
- apiVersion should be v1 instead of v11



- Correct syntax



- The pod is deployed

4. When you solve all the syntax errors your pod should be deployed but is it running? What is the status of your pod?

```
PS D:\> kubectl get pods
NAME         READY   STATUS             RESTARTS   AGE
static-web   0/1     ImagePullBackOff   0          10m
PS D:\>
```

- The status it states ImagePullBackOff
- The status `ImagePullBackOff` means that a Pod couldn't start, because Kubernetes couldn't pull a container image. The 'BackOff' part means that Kubernetes will keep trying to pull the image, with an increasing delay ('back-off').

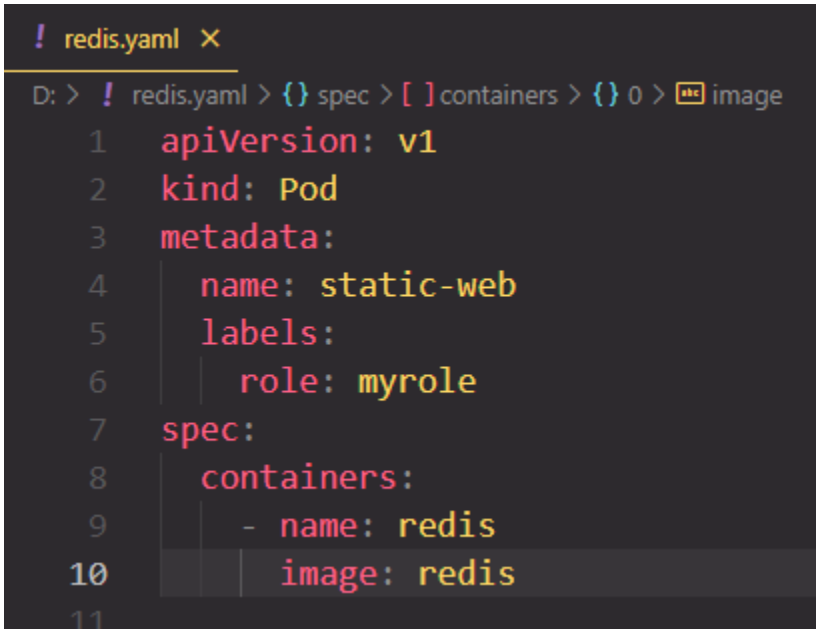
5. Check the events associated with this pod. Run the kubectl describe pod static-web command. What are the events showing? Why your pod is not running?

```
PS D:\> kubectl describe pod static-web
Name:             static-web
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Wed, 05 Apr 2023 16:03:28 +0200
Labels:           role=myrole
Annotations:      <none>
Status:           Pending
IP:               10.244.0.4
IPs:
  IP:  10.244.0.4
Containers:
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason     Age                  From               Message
  ----     ------     ----                 ----               -------
  Normal   Scheduled  12m                  default-scheduler  Successfully assigned default/static-web to minikube
  Normal   Pulling    10m (x4 over 12m)    kubelet            Pulling image "redis123"
  Warning  Failed     10m (x4 over 12m)    kubelet            Failed to pull image "redis123": rpc error: code = Unknown desc = Error r
 login': denied: requested access to the resource is denied
  Warning  Failed     10m (x4 over 12m)    kubelet            Error: ErrImagePull
  Warning  Failed     10m (x6 over 12m)    kubelet            Error: ImagePullBackOff
  Normal   BackOff    2m7s (x40 over 12m)  kubelet            Back-off pulling image "redis123"
PS D:\>
```

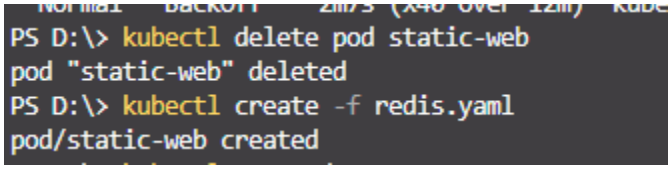
- In the Events section, I get a warning that the in the deployment process of the pod, it failed to pull the image with image name as "**redis123**". The access was denied since either the repository doesn't exist or it may require 'docker login'.

- According to the official documentation, the name of the image should be "**redis**".

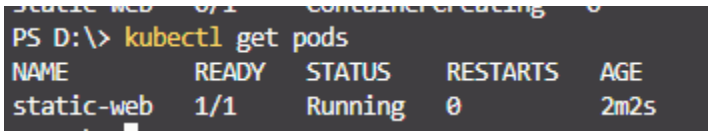
6. Find the correct image (check the Docker hub page) and correct it in the manifest.



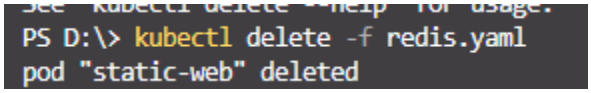
7. Locate the image information and put the correct image name. Redeploy the pod (first run kubectl delete pod static-web to delete the pod, then run kubectl create once again).



8. Check the status of your pod. It should be running now.



9. Now you can delete the pod. Try to delete it using the kubectl delete –f redis.yaml.



10. Your next task is to create and test nginx pod definition. Your definition should use the nginx official image, should use label named app with value frontend and should publish port 80. Make sure you complete this task because we will use this template in our next Labs. Your nginx pod should be running without any issues.

This is the nginx pod definition file:

nginx.yaml

omeworks > ! nginx.yaml > {} spec > [ ] containers > {} 0 > [ ] ports > {} 0

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: frontend
  labels:
    role: myrole
spec:
  containers:
    - name: web
      image: nginx
      ports:
        - name: web
          containerPort: 80
          protocol: TCP
```

- Here we can see the pod is running

```
PS D:\> kubectl create -f nginx.yaml
pod/frontend created
PS D:\> kubectl get pods
NAME       READY   STATUS              RESTARTS   AGE
frontend   0/1     ContainerCreating   0          33s
PS D:\> kubectl get pods
NAME       READY   STATUS    RESTARTS   AGE
frontend   1/1     Running   0          90s
```

11. Final task of this practice will be to define pod definition with following details:
- Image=memcached
- Port= 11211

- Label app=web
- CPU request=0.35 cores
- RAM request=0.15 GB
- CPU limit=0.5 cores
- **Ram limit=0.25 GB**
- Restart policy=Never

12. Don’t forget to try your pod definition.

```
pod/web created
```

Practice3: Multi-container pods

1. Once finished you can try to create multi-container pod definition. Your multi-container pod should use redis and nginx containers with port 6379 and 80 published respectively. Label name should be app with value web.

multi-container.yaml

D: > multi-container.yaml > {} spec > [ ] containers > {} 1 > [ ] ports

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: web2
  labels:
    app: web
spec:
  containers:
    - name: redis
      image: redis:latest
      ports:
        - containerPort: 6379
    - name: nginx
      image: nginx
      ports:
        - containerPort: 80
```

2. Note that in reality there is no sense to put the redis and nginx under the same pod but it can be done for the purpose of learning.

3. Deploy your multi-container pod. It should have running status. What is written under Ready column when you kubectl get the pods? Why your pod displays different values for ready?

```
PS D:\> kubectl create -f multi-container.yaml
pod/web2 created
```

```
web2    2/2    Running    0    33s
```

- Here we can see our web2 pod is running

```
PS D:\> kubectl get pods
NAME   READY   STATUS    RESTARTS   AGE
web2   2/2     Running   0          7s
```

- Our web2 pod has value 2/2 under Ready column. It shows this way because we have deployed 2 containers in the same pod - nginx and redis.

4. Kubectl describe you new pod, and locate the containers section. How many containers are listed?

```
web2      2/2     Running            0          33s
PS D:\> kubectl describe pod web2
Name:             web2
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Wed, 05 Apr 2023 17:46:40 +0200
Labels:           app=web
Annotations:      <none>
Status:           Running
IP:               10.244.0.9
IPs:
  IP:  10.244.0.9
Containers:
  redis:
    Container ID:   docker://7c49da9ed615954bfc3fc543803b1e8c481d09a0301842eae671543ea45f528c
    Image:          redis
    Image ID:       docker-pullable://redis@sha256:7b83a0167532d4320a87246a815a134e19e31504d85e8e55f0bb5bb9edf70448
    Port:           6379/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Wed, 05 Apr 2023 17:46:45 +0200
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  2m32s  default-scheduler  Successfully assigned default/web2 to minikube
  Normal  Pulling    2m31s  kubelet            Pulling image "redis"
  Normal  Pulled     2m29s  kubelet            Successfully pulled image "redis" in 1.856134923s (1.856147345s including waiting)
  Normal  Created    2m29s  kubelet            Created container redis
  Normal  Started    2m28s  kubelet            Started container redis
  Normal  Pulling    2m28s  kubelet            Pulling image "nginx"
  Normal  Pulled     2m26s  kubelet            Successfully pulled image "nginx" in 1.965341326s (1.96536559s including waiting)
  Normal  Created    2m26s  kubelet            Created container nginx
  Normal  Started    2m26s  kubelet            Started container nginx
```

There is only 1 container:

```
Containers:
  redis:
    Container ID:   docker://7c49da9ed615954bfc3fc543803b1e8c481d09a0301842eae671543ea45f528c
    Image:          redis
    Image ID:       docker-pullable://redis@sha256:7b83a0167532d4320a87246a815a134e19e31504d85e8e55f0bb5bb9edf70448
    Port:           6379/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Wed, 05 Apr 2023 17:46:45 +0200
    Ready:          True
    Restart Count:  0
    Environment:    <none>
```

5. Delete all the pods under the default namespace.

6. Don’t delete any of the manifest files you have created so far

Practice4: Probes

1. First we will create and test liveness probe with exec test. Create a file named probes_exec.yaml with following content:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: liveness-exec
  labels:
    app: web
spec:
  containers:
    - name: liveness
      image: k8s.gcr.io/busybox
      args:
        - /bin/sh
        - -c
        - touch /tmp/healthy; sleep 30; rm -rf /tmp/healthy; sleep
        600
      livenessProbe:
        exec:
          command:
            - cat
            - /tmp/healthy
        initialDelaySeconds: 5
        periodSeconds: 5
```

2. Examine the containers args commands especially the line that start with touch. This bash pipeline will help us to test the liveness probes.

3. Run kubectl create –f probes_exec.yaml.

```
PS D:\> kubectl create -f probes_exec.yaml
pod/liveness-exec created
```

4. Run kubectl describe pod liveness-exec immediately after you deploy the pod. The output should indicate that no liveness probes have failed yet.

```
        describe
PS D:\> kubectl describe pod liveness-exec
Name:             liveness-exec
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Wed, 05 Apr 2023 19:43:54 +0200
Labels:           app=web
Annotations:      <none>
Status:           Running
IP:               10.244.0.16
IPs:
  IP:  10.244.0.16
Containers:
  liveness:
    Container ID:  docker://7c592f26c658fca0ddad9018375a32769721dbbe6b20fd2f966941a05441452e
    Image:         k8s.gcr.io/busybox
  kube-api-access-7cwpt:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  2m35s              default-scheduler  Successfully assigned default/liveness-exec to minikube
  Normal   Pulled     2m32s              kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 2.446740694s (2.446761285s including waiting)
  Normal   Pulled     78s                kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 1.397228603s (1.397249921s including waiting)
  Warning  Unhealthy  35s (x6 over 2m)   kubelet            Liveness probe failed: cat: can't open '/tmp/healthy': No such file or directory
  Normal   Killing    35s (x2 over 110s)  kubelet            Container liveness failed liveness probe, will be restarted
  Normal   Pulling    5s (x3 over 2m34s)  kubelet            Pulling image "k8s.gcr.io/busybox"
  Normal   Created    3s (x3 over 2m32s)  kubelet            Created container liveness
  Normal   Started    3s (x3 over 2m31s)  kubelet            Started container liveness
  Normal   Pulled     3s                 kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 1.390842806s (1.390862173s including waiting)
PS D:\>
```

- We can see in the Events section that the liveness container was started successfully:

```
                        node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  2m35s              default-scheduler  Successfully assigned default/liveness-exec to minikube
  Normal   Pulled     2m32s              kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 2.446740694s (2.446761285s including waiting)
  Normal   Pulled     78s                kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 1.397228603s (1.397249921s including waiting)
  Warning  Unhealthy  35s (x6 over 2m)   kubelet            Liveness probe failed: cat: can't open '/tmp/healthy': No such file or directory
  Normal   Killing    35s (x2 over 110s)  kubelet            Container liveness failed liveness probe, will be restarted
  Normal   Pulling    5s (x3 over 2m34s)  kubelet            Pulling image "k8s.gcr.io/busybox"
  Normal   Created    3s (x3 over 2m32s)  kubelet            Created container liveness
  Normal   Started    3s (x3 over 2m31s)  kubelet            Started container liveness
  Normal   Pulled     3s                 kubelet            Successfully pulled image "k8s.gcr.io/busybox" in 1.390842806s (1.390862173s including waiting)
PS D:\>
```

5. After 35 seconds, view the Pod events again. Run kubectl describe pod liveness-exec.

```
PS D:\> kubectl describe pod liveness-exec
Name:             liveness-exec
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Wed, 05 Apr 2023 19:43:54 +0200
Labels:           app=web
Annotations:      <none>
Status:           Running
IP:               10.244.0.16
IPs:
  IP:  10.244.0.16
Containers:
  liveness:
    Container ID:  docker://869f3c3d3bbcda3356278fae19dec400dbf92b15ce987c8c8c2b5ca3a275a1d6
    Image:         k8s.gcr.io/busybox
    Image ID:      docker-pullable://k8s.gcr.io/busybox@sha256:d8d3bc2c183ed2f9f10e7258f84971202325ee6011ba137112e01e30f206de67
    Port:          <none>
    Host Port:     <none>
    Args:
      /bin/sh
      -c
      touch /tmp/healthy; sleep 30; rm -rf /tmp/healthy; sleep 600
    State:          Running
      Started:      Wed, 05 Apr 2023 19:47:41 +0200
    Last State:     Terminated
      Reason:       Error
      Exit Code:    137
      Started:      Wed, 05 Apr 2023 19:46:26 +0200
      Finished:     Wed, 05 Apr 2023 19:47:39 +0200
    Ready:          True
    Restart Count:  3
```

6. At the bottom of the output, there should be a messages indicating that the liveness probes have failed, and the containers have been killed and recreated.

```
Warning  Unhealthy  34s (x9 over 3m14s)  kubelet            Liveness probe failed: cat: can't open '/tmp/healthy': No such file or directory
Normal   Killing    34s (x3 over 3m4s)   kubelet            Container liveness failed liveness probe, will be restarted
Normal   Pulling    4s (x4 over 3m48s)   kubelet            Pulling image "k8s.gcr.io/busybox"
```

7. Wait another 30 seconds, and verify that the container has been restarted. Run kubectl get pod livenessexec.

```
Normal   Pulling    4s (x4 over 3m48s)   kubelet            Pull
PS D:\> kubectl get pod liveness-exec
NAME            READY   STATUS    RESTARTS      AGE
liveness-exec   1/1     Running   3 (74s ago)   4m59s
PS D:\>
```

8. The output should show that RESTARTS has been incremented.

```
RESTARTS
4 (31s ago)
```

- Now the number of restarts has increased to 4, compared to the previous case when it was 3.

9. We will continue with HTTP probe. Create file named probes_http.yaml with following content:

```yaml
apiVersion: v1
kind: Pod
metadata:
  labels:
  test: liveness
  name: liveness-http
spec:
  containers:
    - name: liveness
  image: k8s.gcr.io/liveness
  args:
    - /server
  livenessProbe:
  httpGet:
  path: /healthz
  port: 8080
  httpHeaders:
    - name: Custom-Header
  value: Awesome
  initialDelaySeconds: 3
  periodSeconds: 3
```

10. Just for your info, /healtz handler has following function implemented:

```go
http.HandleFunc("/healthz", func(w http.ResponseWriter, r *http.Request) {
  duration := time.Now().Sub(started)
  if duration.Seconds() > 10 {
    w.WriteHeader(500)
    w.Write([]byte(fmt.Sprintf("error: %v", duration.Seconds())))
  } else {
    w.WriteHeader(200)
    w.Write([]byte("ok"))
  }
})
```

11. For the first 10 seconds that the container is alive, the /healthz handler returns a status of 200. After that, the handler returns a status of 500.

```
Normal   Pulled     12s                kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.231878415s (1.231884872s including waiting)
Normal   Started    11s (x3 over 47s)  kubelet            Started container liveness
Warning  Unhealthy  1s (x7 over 37s)   kubelet            Liveness probe failed: HTTP probe failed with statuscode: 500
```

12. Run kubectl create –f probes_http.yaml.

```
PS D:\> kubectl create -f probes_http.yaml
pod/liveness-http created
```

13. Immediately run (you only have 10 secs to run this command) kubectl describe pod liveness-http.

```
Normal  Pulled     13s   kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.466386708s (1.466410333s including waiting)
Normal  Created    13s   kubelet            Created container liveness
```

14. Your pod should be live and running.

```
PS D:\> kubectl get pods liveness-http
NAME            READY   STATUS    RESTARTS      AGE
liveness-http   1/1     Running   1 (17s ago)   38s
```

15. After 10 seconds, view Pod events to verify that liveness probes have failed and the container has been restarted. Run again kubectl describe pod liveness-http.

```
                    node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  2m7s               default-scheduler  Successfully assigned default/liveness-http to minikube
  Normal   Pulled     2m3s               kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 2.721567373s (2.721586729s including waiting)
  Normal   Pulled     105s               kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.266623396s (1.26665157s including waiting)
  Normal   Created    87s (x3 over 2m2s) kubelet            Created container liveness
  Normal   Pulled     87s                kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.231878415s (1.231884872s including waiting)
  Normal   Started    86s (x3 over 2m2s) kubelet            Started container liveness
  Normal   Pulling    70s (x4 over 2m5s) kubelet            Pulling image "k8s.gcr.io/liveness"
  Warning  Unhealthy  70s (x9 over 112s) kubelet            Liveness probe failed: HTTP probe failed with statuscode: 500
  Normal   Killing    70s (x3 over 106s) kubelet            Container liveness failed liveness probe, will be restarted
```

16. You should see the same output as in step 7. Kubelet will reboot he container.

```
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  95s                default-scheduler  Successfully assigned default/liveness-http to minikube
  Normal   Pulled     93s                kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.466386708s (1.466410333s including waiting)
  Normal   Pulled     73s                kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.246246882s (1.24628027s including waiting)
  Normal   Created    55s (x3 over 93s)  kubelet            Created container liveness
  Normal   Pulled     55s                kubelet            Successfully pulled image "k8s.gcr.io/liveness" in 1.251337911s (1.251358378s including waiting)
  Normal   Started    54s (x3 over 93s)  kubelet            Started container liveness
  Normal   Pulling    38s (x4 over 94s)  kubelet            Pulling image "k8s.gcr.io/liveness"
  Warning  Unhealthy  38s (x9 over 80s)  kubelet            Liveness probe failed: HTTP probe failed with statuscode: 500
  Normal   Killing    38s (x3 over 74s)  kubelet            Container liveness failed liveness probe, will be restarted
```

- It’s giving status code 500 again

17. We continue with TCP probes. Create file named probes_tcp.yaml with following content:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: liveness-tcp
  labels:
    app: goproxy
spec:
  containers:
    - name: goproxy
      image: k8s.gcr.io/goproxy:0.1
      ports:
        - containerPort: 8080
      livenessProbe:
        tcpSocket:
          port: 9999 #8080 is valid port
        initialDelaySeconds: 3
        periodSeconds: 3
```

18. Run kubectl create –f probes_tcp.yaml.

```
PS D:\> kubectl create -f probes_tcp.yaml
pod/liveness-tcp created
```

19. Immediately run (you only have 10 secs to run this command) kubectl describe pod liveness-tcp.

```
Normal  Pulling    8s    kubelet           Pulling image "k8s.gcr.io/goproxy:0.1"
Normal  Pulled     5s    kubelet           Successfully pulled image "k8s.gcr.io/goproxy:0.1" in 3.29358175s (3.293632135s including waiting)
Normal  Created    5s    kubelet           Created container goproxy
Normal  Started    4s    kubelet           Started container goproxy
```

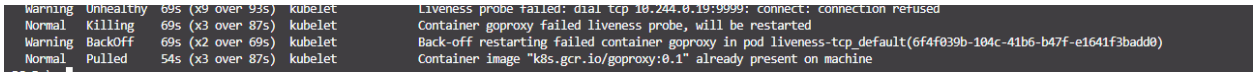
20. Your pod should be live and running.

```
PS D:\> kubectl get pods liveness-tcp
NAME           READY   STATUS    RESTARTS      AGE
liveness-tcp   1/1     Running   1 (7s ago)    22s
```

21. After 10 seconds, view Pod events to verify that liveness probes have failed and the container has been restarted. Run again kubectl describe pod liveness-tcp.

```
Normal   Started    19s (x3 over 38s)  kubelet           Started container goproxy
Normal   Pulled     19s (x2 over 28s)  kubelet           Container image "k8s.gcr.io/goproxy:0.1" already present on machine
Warning  Unhealthy  10s (x9 over 34s)  kubelet           Liveness probe failed: dial tcp 10.244.0.19:9999: connect: connection refused
Normal   Killing    10s (x3 over 28s)  kubelet           Container goproxy failed liveness probe, will be restarted
Warning  BackOff    10s (x2 over 10s)  kubelet           Back-off restarting failed container goproxy in pod liveness-tcp_default(6f4f039b-104c-41b6-b47f-e1641f3badd0)
S D:\>
```

22. You should see the same output as in step 7 and 16. Kubelet will reboot he container.



- We get the same failure as in steps 7 and 16.

23. Our last job will be to define one readiness probe using HTTP test.

24. Create file named readiness_http.yaml with following content:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: readiness-http
  labels:
    app: test
spec:
  containers:
    - name: nginx
      image: nginx
      ports:
        - containerPort: 80
      readinessProbe:
        initialDelaySeconds: 1
        periodSeconds: 2
        timeoutSeconds: 1
        successTreshold: 1
        failureTreshold: 1
        httpGet:
          host:
          scheme: HTTP
          path: /
          httpHeaders:
            - name: Host
              value: myapplication1.com
          port: 80
```

25. Run kubectl create –f readiness_http.yaml.

```
PS D:\> kubectl get pods readiness-http
NAME             READY   STATUS    RESTARTS   AGE
readiness-http   1/1     Running   0          79s
```

- I've created the pod and now I'm checking its status

26. Run kubectl get pods –A to see the status of your pod.

```
PS D:\> kubectl get pods -A
NAMESPACE     NAME                                 READY   STATUS             RESTARTS         AGE
default       liveness-exec                        1/1     Running            16 (5m38s ago)   47m
default       liveness-http                        0/1     CrashLoopBackOff   15 (2m38s ago)   33m
default       liveness-tcp                         0/1     CrashLoopBackOff   13 (4m4s ago)    27m
default       my-release-nginx-6c6dd45bcd-bgxwq    1/1     Running            0                128m
default       my-release2-kafka-0                  1/1     Running            5 (96m ago)      103m
default       my-release2-zookeeper-0              1/1     Running            0                103m
default       readiness-http                       1/1     Running            0                112s
kube-system   coredns-787d4945fb-xph2k             1/1     Running            1 (4h43m ago)    4h46m
kube-system   etcd-minikube                        1/1     Running            1 (4h43m ago)    4h46m
kube-system   kube-apiserver-minikube              1/1     Running            1 (4h43m ago)    4h46m
kube-system   kube-controller-manager-minikube     1/1     Running            1 (4h43m ago)    4h46m
kube-system   kube-proxy-qx2ww                     1/1     Running            1 (4h43m ago)    4h46m
kube-system   kube-scheduler-minikube              1/1     Running            1 (4h43m ago)    4h46m
kube-system   storage-provisioner                  1/1     Running            3 (4h41m ago)    4h46m
PS D:\>
```

27. Pods and their status and ready states will be displayed; our pod should be in running state.

- The pod is in running state

28. Run kubectl describe pod readiness-http. Examine the events for this pod. Everything should be OK.

```
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  2m33s  default-scheduler  Successfully assigned default/readiness-http to minikube
  Normal  Pulling    2m31s  kubelet            Pulling image "nginx"
  Normal  Pulled     2m30s  kubelet            Successfully pulled image "nginx" in 1.649537021s (1.649543255s including waiting)
  Normal  Created    2m30s  kubelet            Created container nginx
  Normal  Started    2m30s  kubelet            Started container nginx
```

29. Now delete the pod and edit the readiness_http.yaml so that the port parameter has 81 value.

```
PS D:\> kubectl delete pod readiness-http
pod "readiness-http" deleted
PS D:\>
```

```
    scheme: HTTP
    path: /
    httpHeaders:
      - name: Host
        value: myapplication1.com
    port: 81
```

30. Run again kubectl create –f readiness_http.yaml.

31. Run kubectl get pods –A to see the status of your pod. You should see that the pod is running but it is not in ready state.

```
PS D:\> kubectl get pods -A
NAMESPACE     NAME                                 READY   STATUS             RESTARTS          AGE
default       liveness-exec                        0/1     CrashLoopBackOff   17 (3m40s ago)    53m
default       liveness-http                        0/1     CrashLoopBackOff   17 (2m27s ago)    38m
default       liveness-tcp                         0/1     CrashLoopBackOff   15 (4m14s ago)    32m
default       my-release-nginx-6c6dd45bcd-bgxwq    1/1     Running            0                 134m
default       my-release2-kafka-0                  1/1     Running            5 (101m ago)      109m
default       my-release2-zookeeper-0              1/1     Running            0                 109m
default       readiness-http                       0/1     Running            0                 51s
kube-system   coredns-787d4945fb-xph2k             1/1     Running            1 (4h49m ago)     4h52m
kube-system   etcd-minikube                        1/1     Running            1 (4h49m ago)     4h52m
kube-system   kube-apiserver-minikube              1/1     Running            1 (4h49m ago)     4h52m
kube-system   kube-controller-manager-minikube     1/1     Running            1 (4h49m ago)     4h52m
kube-system   kube-proxy-qx2ww                     1/1     Running            1 (4h49m ago)     4h52m
kube-system   kube-scheduler-minikube              1/1     Running            1 (4h49m ago)     4h52m
kube-system   storage-provisioner                  1/1     Running            3 (4h47m ago)     4h52m
```

```
NAME             READY   STATUS    RESTARTS   AGE
readiness-http   0/1     Running   0          6m55s
```

- 0/1 showing the pod is not in ready state

32. Describe the pod. Run kubectl describe pod readiness-http.

33. From the events we can see that readiness probe failed due to the connection being refused therefore pod will not receive any traffic.

```
Events:
  Type     Reason     Age                   From               Message
  ----     ------     ----                  ----               -------
  Normal   Scheduled  7m38s                 default-scheduler  Successfully assigned default/readiness-http to minikube
  Normal   Pulling    7m37s                 kubelet            Pulling image "nginx"
  Normal   Pulled     7m35s                 kubelet            Successfully pulled image "nginx" in 1.621034761s (1.621053745s including waiting)
  Normal   Created    7m35s                 kubelet            Created container nginx
  Normal   Started    7m35s                 kubelet            Started container nginx
  Warning  Unhealthy  2m35s (x154 over 7m34s)  kubelet         Readiness probe failed: Get "http://10.244.0.21:81/": dial tcp 10.244.0.21:81: connect: connection refused
```

34. Delete all pods under the default namespace.

```
PS D:\> kubectl delete pods --all -n default
pod "liveness-exec" deleted
pod "liveness-http" deleted
pod "liveness-tcp" deleted
pod "my-release-nginx-6c6dd45bcd-bgxwq" deleted
pod "my-release2-kafka-0" deleted
pod "my-release2-zookeeper-0" deleted
pod "readiness-http" deleted
PS D:\>
```

35. Don’t delete any manifest files created so far