Content

Install Minikube

1. Install minikube.exe according to this website https://minikube.cn/docs/start/?arch=%2Fwindows%2Fx86-64%2Fstable%2F.exe+download.
2. Add minikube.exe binary file to my PATH.
   Command:

```
$oldPath = [Environment]::GetEnvironmentVariable('Path', [EnvironmentVariableTarget]::Machine)
if ($oldPath.Split(';') -inotcontains 'C:\minikube'){
  [Environment]::SetEnvironmentVariable('Path', $('{0};C:\minikube' -f $oldPath), [EnvironmentVariableTarget]::Machine)
}
```

```
PS C:\WINDOWS\system32> $oldPath = [Environment]::GetEnvironmentVariable('Path', [EnvironmentVariableTarget]::Machine)
PS C:\WINDOWS\system32> if ($oldPath.Split(';') -inotcontains 'C:\minikube'){
>>   [Environment]::SetEnvironmentVariable('Path', $('{0};C:\minikube' -f $oldPath), [EnvironmentVariableTarget]::Machine)
>> }
>>
PS C:\WINDOWS\system32>
```

```
PS C:\WINDOWS\system32> minikube
minikube 提供并管理针对开发工作流程优化的本地 Kubernetes 集群。

基本命令:
  start            启动本地 Kubernetes 集群
  status           获取本地 Kubernetes 集群状态
  stop             停止正在运行的本地 Kubernetes 集群
  delete           删除本地的 Kubernetes 集群
  dashboard        访问在 minikube 集群中运行的 kubernetes dashboard
  pause            暂停 Kubernetes
  unpause          恢复 Kubernetes

镜像命令
  docker-env       提供将终端的 docker-cli 指向 minikube 内部 Docker Engine 的说明。（用于直接在 minikube 内构建 docker
镜像）
  podman-env       配置环境以使用 minikube's Podman service
  cache            管理 images 缓存
  image            管理 images
```

Note: When running PowerShell as administrator, C:\minukube cannot be found in the terminal.

3. Create a minikube cluster
   Command: *minikube start*
   Problems that I met as the following photo

```
PS C:\WINDOWS\system32> minikube start
* Microsoft Windows 11 Home China 10.0.26100.6584 Build 26100.6584 上的 minikube v1.37.0
E1017 10:37:08.963312   10892 start.go:829] api.Load failed for minikube: filestore "minikube": Docker machine "minikube" does not exist. Use "docker-machine ls" to list machines. Use "docker-machine create" to add a new one.
* 根据现有的配置文件使用 hyperv 驱动程序。
* 在集群中 "minikube" 启动节点 "minikube" primary control-plane
* 正在创建 hyperv VM (CPUs=2, 内存=6144MB, 磁盘=20000MB) ...
! StartHost 失败，将要重试: creating host: create: precreate: Hyper-V PowerShell Module is not available
* 正在创建 hyperv VM (CPUs=2, 内存=6144MB, 磁盘=20000MB) ...
* 启动 hyperv VM 失败。运行 "minikube delete" 可能需要修复它： creating host: create: precreate: Hyper-V PowerShell Module is not available

X 因 PR_HYPERV_MODULE_NOT_INSTALLED 错误而退出: Failed to start host: creating host: create: precreate: Hyper-V PowerShell Module is not available
* 建议: 运行: 'Enable-WindowsOptionalFeature -Online -FeatureName Microsoft-Hyper-V-Tools-All -All'
* 文档: https://www.altaro.com/hyper-v/install-hyper-v-powershell-module/
* 相关问题: https://github.com/kubernetes/minikube/issues/9040

PS C:\WINDOWS\system32> minikube delete --all
* 已删除所有关于 "minikube" 集群的痕迹。
* 成功删除所有配置文件
PS C:\WINDOWS\system32> docker system prune -a
WARNING! This will remove:
  - all stopped containers
  - all networks not used by at least one container
  - all images without at least one container associated to them
  - all build cache

Are you sure you want to continue? [y/N] y
Total reclaimed space: 0B
```

Solutions:

First, *enter minikube delete* and *docker system prune -a* to delete all traces of the "minikube" cluster and all configuration files. Then enter *minikube start --driver=docker --image-repository=registry.cn-hangzhou.aliyuncs.com/google_containers*, which it is explicitly specified as Docker and a domestic mirror site is used.


```
PS C:\Users\陈芷薇> cd .\.minikube\
PS C:\Users\陈芷薇\.minikube> cd .\cache\
PS C:\Users\陈芷薇\.minikube\cache> dir


    目录: C:\Users\陈芷薇\.minikube\cache


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        2025/10/17     10:24                images
d-----        2025/10/17     10:26                iso
d-----        2025/10/17     10:18                kic
d-----        2025/10/17     10:30                preloaded-tarball


PS C:\Users\陈芷薇\.minikube\cache> cd .\preloaded-tarball\
PS C:\Users\陈芷薇\.minikube\cache\preloaded-tarball> dir


    目录: C:\Users\陈芷薇\.minikube\cache\preloaded-tarball


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        2025/10/17     10:30      353447550 preloaded-images-k8s-v18-v1.34.0-docker-overlay2-amd64.tar.lz4
-a----        2025/10/17     10:30             16 preloaded-images-k8s-v18-v1.34.0-docker-overlay2-amd64.tar.lz4.checksum
```

Seeing the length of 353447550 in the cache explains why it took so long to download.

Hello Minikube

1. Open the Dashboard

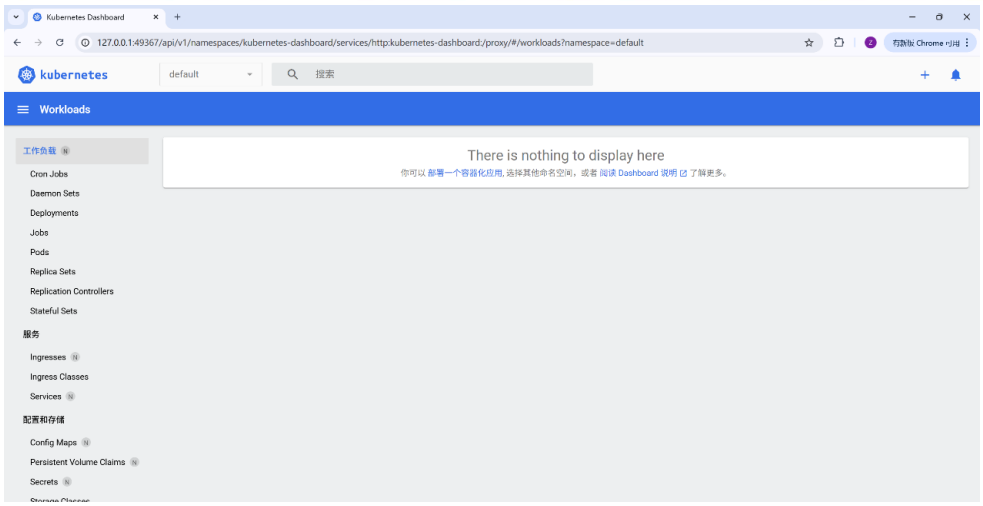
   Command: *minikube dashboard*

   The *dashboard* command enables the dashboard add-on and opens the proxy in the default web browser. We can create Kubernetes resources on the dashboard such as Deployment and Service.

```
PS C:\Users\陈芷薇> minikube dashboard
  - 正在使用镜像 docker.io/kubernetesui/metrics-scraper:v1.0.8
* 某些仪表板功能需要 metrics-server 插件。要启用所有功能，请运行：

        minikube addons enable metrics-server

* 正在验证 dashboard 运行情况 ...
* 正在启动代理...
* 正在验证 proxy 运行状况 ...
* 正在使用默认浏览器打开 http://127.0.0.1:49367/api/v1/namespaces/kubernetes-dashboard/services/http:kubernetes-dashboard:/proxy/ ...
```



2. Create a deployment

2.1. Use the kubectl create command to create a Deployment that manages a Pod. The Pod runs a Container based on the provided Docker image.

kubectl create deployment hello-node --image=registry.k8s.io/e2e-test-images/agnhost:2.53 -- /agnhost netexec --http-port=8080

2.2. View the deployment

kubectl get deployments

2.3. View the pod

kubectl get pods

```
PS C:\Users\陈芷薇> kubectl create deployment hello-node --image=registry.k8s.io/e2e-
test-images/agnhost:2.53 -- /agnhost netexec --http-port=8080
deployment.apps/hello-node created
PS C:\Users\陈芷薇> kubectl get deployments
NAME         READY   UP-TO-DATE   AVAILABLE   AGE
hello-node   1/1     1            1           42s
PS C:\Users\陈芷薇> kubectl get pods
NAME                          READY   STATUS    RESTARTS   AGE
hello-node-6c9b5f4b59-rr9j2   1/1     Running   0          48s
```

2.4. View cluster events:

kubectl get events

```
PS C:\Users\陈芷薇> kubectl get events
LAST SEEN   TYPE      REASON                          OBJECT
        MESSAGE
96s         Normal    Scheduled                       pod/hello-node-6c9b5f4b59-r
r9j2    Successfully assigned default/hello-node-6c9b5f4b59-rr9j2 to minikube
96s         Normal    Pulling                         pod/hello-node-6c9b5f4b59-r
r9j2    Pulling image "registry.k8s.io/e2e-test-images/agnhost:2.53"
75s         Normal    Pulled                          pod/hello-node-6c9b5f4b59-r
r9j2    Successfully pulled image "registry.k8s.io/e2e-test-images/agnhost:2.53" in 2
2.231s (22.231s including waiting). Image size: 139374622 bytes.
75s         Normal    Created                         pod/hello-node-6c9b5f4b59-r
r9j2    Created container: agnhost
75s         Normal    Started                         pod/hello-node-6c9b5f4b59-r
r9j2    Started container agnhost
96s         Warning   FailedCreate                    replicaset/hello-node-6c9b5
f4b59   Error creating: Unauthorized
96s         Normal    SuccessfulCreate                replicaset/hello-node-6c9b5
f4b59   Created pod: hello-node-6c9b5f4b59-rr9j2
96s         Warning   ReplicaSetCreateError           deployment/hello-node
        Failed to create new replica set "hello-node-6c9b5f4b59": Unauthorized
```

2.5. View the kubectl configuration

kubectl config view

```
PS C:\Users\陈芷薇> kubectl config view
apiVersion: v1
clusters:
- cluster:
    certificate-authority: C:\Users\陈芷薇\.minikube\ca.crt
    extensions:
    - extension:
        last-update: Sun, 14 Dec 2025 15:46:37 CST
        provider: minikube.sigs.k8s.io
        version: v1.37.0
      name: cluster_info
    server: https://127.0.0.1:55618
  name: minikube
contexts:
- context:
    cluster: minikube
    extensions:
    - extension:
        last-update: Sun, 14 Dec 2025 15:46:37 CST
        provider: minikube.sigs.k8s.io
        version: v1.37.0
      name: context_info
    namespace: default
    user: minikube
  name: minikube
current-context: minikube
```

2.6. View application logs for a container in a pod

Here I used *kubectl get pods* to get the pod name as hello-node-6c9bf4b59-rr9j2. And then enter kubectl logs hello-node-6c9bf4b59-rr9j2 to view application logs.

```
PS C:\Users\陈芷薇> kubectl get pods
NAME                          READY   STATUS    RESTARTS   AGE
hello-node-6c9b5f4b59-rr9j2   1/1     Running   0          3m37s
PS C:\Users\陈芷薇> kubectl logs hello-node-6c9b5f4b59-rr9j2
I1214 08:51:06.435357       1 log.go:245] Started HTTP server on port 8080
I1214 08:51:06.435673       1 log.go:245] Started UDP server on port  8081
```

3. Create a service

3.1. Expose the Pod to the public internet

kubectl expose deployment hello-node --type=LoadBalancer --port=8080

3.2. View the Service

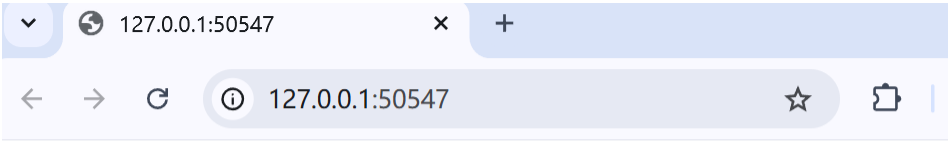
kubectl get services

From the result, it shows that on cloud providers that support load balancers, an external IP address would be provisioned to access the Service. On minikube, the LoadBalancer type makes the Service accessible through the *minikube service* command.

3.3. Open up a browser window that serves my app and shows the app's response.

minikube service hello-node

```
PS C:\Users\陈芷薇> kubectl expose deployment hello-node --type=LoadBalancer --port=8
080
service/hello-node exposed
PS C:\Users\陈芷薇> kubectl get services
NAME         TYPE           CLUSTER-IP      EXTERNAL-IP   PORT(S)          AGE
hello-node   LoadBalancer   10.107.45.191   <pending>     8080:30133/TCP   7s
kubernetes   ClusterIP      10.96.0.1       <none>        443/TCP          58d
PS C:\Users\陈芷薇> minikube service hello-node
┌─────────────┬────────────┬─────────────┬────────────────────────────┐
│  NAMESPACE  │    NAME    │ TARGET PORT │            URL             │
├─────────────┼────────────┼─────────────┼────────────────────────────┤
│  default    │ hello-node │ 8080        │ http://192.168.49.2:30133  │
└─────────────┴────────────┴─────────────┴────────────────────────────┘
* 为服务 hello-node 启动隧道。/┌─────────────┬────────────┬─────────────┬────────────────────────────┐
│  NAMESPACE  │    NAME    │ TARGET PORT │            URL             │
├─────────────┼────────────┼─────────────┼────────────────────────────┤
│  default    │ hello-node │             │ http://127.0.0.1:50547     │
└─────────────┴────────────┴─────────────┴────────────────────────────┘
* 为服务 hello-node 启动隧道。
* 正通过默认浏览器打开服务 default/hello-node...
! 因为你正在使用 windows 上的 Docker 驱动程序，所以需要打开终端才能运行它。
```



NOW: 2025-12-14 08:55:28.633689417 +0000 UTC m=+279.326453054

4. Enable addons

4.1. List the currently supported addons

minikube addons list

```
PS C:\Users\陈芷薇> minikube addons list
┌──────────────────────────┬──────────┬──────────┬──────────────────────┐
│        ADDON NAME        │ PROFILE  │  STATUS  │      MAINTAINER      │
├──────────────────────────┼──────────┼──────────┼──────────────────────┤
│ ambassador               │ minikube │ disabled │ 3rd party (Ambassador)
│ amd-gpu-device-plugin    │ minikube │ disabled │ 3rd party (AMD)
│ auto-pause               │ minikube │ disabled │ minikube
│ cloud-spanner            │ minikube │ disabled │ Google
│ csi-hostpath-driver      │ minikube │ disabled │ Kubernetes
│ dashboard                │ minikube │ enabled ✅ Kubernetes
│ default-storageclass     │ minikube │ enabled ✅ Kubernetes
│ efk                      │ minikube │ disabled │ 3rd party (Elastic)
```

4.2. Enable an “metrics-server” addon

minikube addons enable metrics-server

```
PS C:\Users\陈芷薇> minikube addons enable metrics-server
* metrics-server 是由 Kubernetes 维护的插件。如有任何问题，请在 GitHub 上联系 minikub
e。
您可以在以下链接查看 minikube 的维护者列表：https://github.com/kubernetes/minikube/bl
ob/master/OWNERS
  - 正在使用镜像 registry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v
0.8.0
* 启动 'metrics-server' 插件
```

4.3. View the Pod and Service I created by installing that addon

kubectl get pod,svc -n kube-system

From the picture, it can find the status of "metrics server" is wrong. So entere the command "*kubectl describe pod*" to check its problems.

```
PS C:\Users\陈芷薇> kubectl get pod,svc -n kube-system
NAME                                    READY   STATUS             RESTARTS      AGE
pod/coredns-7ddb67b59b-vtlpf            1/1     Running            1 (70m ago)   58d
pod/etcd-minikube                       1/1     Running            1 (70m ago)   58d
pod/kube-apiserver-minikube             1/1     Running            1 (70m ago)   58d
pod/kube-controller-manager-minikube    1/1     Running            1 (70m ago)   58d
pod/kube-proxy-ts5ll                    1/1     Running            1 (70m ago)   58d
pod/kube-scheduler-minikube             1/1     Running            1 (70m ago)   58d
pod/metrics-server-74576d8779-8kxcg     0/1     ImagePullBackOff   0             19s
pod/storage-provisioner                 1/1     Running            1 (70m ago)   58d

NAME                     TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)
      AGE
service/kube-dns         ClusterIP   10.96.0.10     <none>        53/UDP,53/TCP,9153/
TCP   58d
service/metrics-server   ClusterIP   10.102.77.49   <none>        443/TCP
      19s
PS C:\Users\陈芷薇> kubectl top pods
error: Metrics API not available
```

kubectl describe pod metrics-server-74576d8779-8kxcg -n kube-system

```
PS C:\Users\陈芷薇> kubectl describe pod metrics-server-74576d8779-8kxcg -n kube-system
Name:                 metrics-server-74576d8779-8kxcg
Namespace:            kube-system
Priority:             2000000000
Priority Class Name:  system-cluster-critical
Service Account:      metrics-server
Node:                 minikube/192.168.49.2
Start Time:           Sun, 14 Dec 2025 16:56:51 +0800
Labels:               k8s-app=metrics-server
                      pod-template-hash=74576d8779
Annotations:          <none>
Status:               Pending
IP:                   10.244.0.7
IPs:
  IP:           10.244.0.7
Controlled By:  ReplicaSet/metrics-server-74576d8779
Containers:
  metrics-server:
    Container ID:
    Image:         registry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v
0.8.0@sha256:89258156d0e9af60403eafd44da9676fd66f600c7934d468ccc17e42b199aee2
    Image ID:
    Port:          4443/TCP (https)

Events:
  Type     Reason     Age                   From               Message
  ----     ------     ----                  ----               -------
  Normal   Scheduled  5m55s                 default-scheduler  Successfully assigned k
  Warning  Failed     3m22s (x5 over 5m55s)  kubelet            Failed to pull image "r
egistry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0@sha256:8925815
6d0e9af60403eafd44da9676fd66f600c7934d468ccc17e42b199aee2": Error response from daemon:
 manifest for registry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server@sha256
:89258156d0e9af60403eafd44da9676fd66f600c7934d468ccc17e42b199aee2 not found: manifest u
nknown: manifest unknown
  Warning  Failed     3m22s (x5 over 5m55s)  kubelet            Error: ErrImagePull
  Normal   BackOff    62s (x20 over 5m54s)   kubelet            Back-off pulling image
"registry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0@sha256:89258
156d0e9af60403eafd44da9676fd66f600c7934d468ccc17e42b199aee2"
  Warning  Failed     62s (x20 over 5m54s)   kubelet            Error: ImagePullBackOff
  Normal   Pulling    47s (x6 over 5m55s)    kubelet            Pulling image "registry
.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0@sha256:89258156d0e9af
60403eafd44da9676fd66f600c7934d468ccc17e42b199aee2"
```

Cause:

it's not a network timeout, but rather the image reference syntax leading to a "manifest not found" error. The `manifest for .../metrics-server@sha256:8925... not found: manifest unknown` indicates that the current image is written as a "tag + digest": `registry.cn-

hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0@sha256:8925...`. Many image acceleration/synchronization repositories (including your Alibaba Cloud path) may not retain or support the manifest corresponding to this digest. As a result, although `v0.8.0` may exist, the precise fingerprint `@sha256:...` cannot be found in that repository ⇒ pull will inevitably fail ⇒ `ImagePullBackOff` ⇒ `kubectl top` will also show no metrics.

Solution:

kubectl set image deploy/metrics-server -n kube-system metrics-server=registry.vn-hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0

kubectl rollout restart deploy/metrics-server -n kube-system deployment.apps/metrics-server restarted

kubectl get pod -n kube-system | findstr metrics-server

kubectl get apiservice v1beta1.metrics.k8s.io

```
PS C:\Users\陈芷薇> kubectl set image deploy/metrics-server -n kube-system metrics-serv
er=registry.cn-hangzhou.aliyuncs.com/google_containers/metrics-server:v0.8.0
deployment.apps/metrics-server image updated
PS C:\Users\陈芷薇> kubectl rollout restart deploy/metrics-server -n kube-system
deployment.apps/metrics-server restarted
PS C:\Users\陈芷薇> kubectl get pod -n kube-system | findstr metrics-server
metrics-server-695fb89df7-75562    1/1     Running   0             5s
PS C:\Users\陈芷薇> kubectl get apiservice v1beta1.metrics.k8s.io
NAME                     SERVICE                      AVAILABLE   AGE
v1beta1.metrics.k8s.io   kube-system/metrics-server   True        7m39s
```

Final result: new metrics-server is running and the command *kubectl top pods* returns its name, CPU and momory rather than “error: Metrics API not available”.

```
PS C:\Users\陈芷薇> kubectl get pod,svc -n kube-system
NAME                                   READY   STATUS         RESTARTS      AGE
pod/coredns-7ddb67b59b-vtlpf           1/1     Running        1 (82m ago)   58d
pod/etcd-minikube                      1/1     Running        1 (82m ago)   58d
pod/kube-apiserver-minikube            1/1     Running        1 (82m ago)   58d
pod/kube-controller-manager-minikube   1/1     Running        1 (82m ago)   58d
pod/kube-proxy-ts5ll                   1/1     Running        1 (82m ago)   58d
pod/kube-scheduler-minikube            1/1     Running        1 (82m ago)   58d
pod/metrics-server-5497666c-kpztq      0/1     ErrImagePull   0             8s
pod/metrics-server-695fb89df7-75562    1/1     Running        0             4m58s
pod/storage-provisioner                1/1     Running        1 (82m ago)   58d

NAME                     TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)
    AGE
service/kube-dns         ClusterIP   10.96.0.10     <none>        53/UDP,53/TCP,9153/TC
P   58d
service/metrics-server   ClusterIP   10.102.77.49   <none>        443/TCP
    12m
PS C:\Users\陈芷薇> kubectl top pods
NAME                          CPU(cores)   MEMORY(bytes)
hello-node-6c9b5f4b59-rr9j2   1m           7Mi
```

4.4. Disable metrics-server

minikube addons disable metrics-server

5. Cleanup

5.1. Clean up the resources I created in my cluster

kubectl delete service hello-node

kubectl delete deployment hello-node

5.2. Stop the Minikube cluster

minikube stop

```
PS C:\Users\陈芷薇> minikube addons disable metrics-server
* 'metrics-server' 插件已被禁用
PS C:\Users\陈芷薇> kubectl delete service hello-node
service "hello-node" deleted from default namespace
PS C:\Users\陈芷薇> kubectl delete deployment hello-node
deployment.apps "hello-node" deleted from default namespace
PS C:\Users\陈芷薇> minikube stop
* 正在停止节点 "minikube" ...
* 正在通过 SSH 关闭“minikube”…
* 1 个节点已停止。
```

Using kubectl to Create a Deployment

1. Deploy an app

1.1. Use *kubectl create deployment* command to deploy the first app with the provided deployment name and app image location.

```
PS C:\Users\陈芷薇> kubectl create deployment kubernetes-bootcamp --image=gcr.io/google
-samples/kubernetes-bootcamp:v1
deployment.apps/kubernetes-bootcamp created
```

1.2. List deployments use the *kubectl get deployments* command

```
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   1/1     1            1           5m29s
```

2. View the app

Open a second terminal window to run the proxy with the command *kubectl proxy*. Then query the version directly through the API using the *curl* command

```
PS C:\Users\陈芷薇> curl http://localhost:8001/version

Security Warning: Script Execution Risk
Invoke-WebRequest parses the content of the web page. Script code in the web page
might be run when the page is parsed.
      RECOMMENDED ACTION:
      Use the -UseBasicParsing switch to avoid script code execution.

      Do you want to continue?

[Y] 是(Y)  [A] 全是(A)  [N] 否(N)  [L] 全否(L)  [S] 暂停(S)  [?] 帮助
(默认值为“N”):y


StatusCode        : 200
StatusDescription : OK
Content           : {
                      "major": "1",
                      "minor": "34",
                      "emulationMajor": "1",
                      "emulationMinor": "34",
                      "minCompatibilityMajor": "1",
                      "minCompatibilityMinor": "33",
                      "gitVersion": "v1.34.0",
```

First, get the Pod name and store it in the environment variable POD_NAME. Then access the Pod through the proxied API

```
PS C:\Users\陈芷薇> $POD_NAME = kubectl get pods -o jsonpath="{.items[0].metadata.name}
"
PS C:\Users\陈芷薇> echo "Name of the Pod: $POD_NAME"
Name of the Pod: kubernetes-bootcamp-658f6cbd58-rfjkh
```

Problem：due to how Windows PowerShell parses commands and variables

Reason 1. In PowerShell:

- curl is actually an alias for Invoke-WebRequest
- It doesn't handle $POD_NAME like bash does
- As a result, $POD_NAME:8080/proxy is treated as a strange string

The Kubernetes API mistakenly thinks you are accessing /pods/proxy, so it returns "pods "proxy" not found".

Reason 2:

Variable concatenation is incorrect in PowerShell. In PowerShell, a colon (:) immediately following a variable will cause parsing failure.

Reason 3:

kubectl proxy should run in the same terminal, such as PowerShell, not one PowerShell and one CMD.

```
PS C:\Users\陈芷薇> curl http://localhost:8001/api/v1/namespaces/default/pods/$POD_NAME
:8080/proxy/
curl : { "kind": "Status", "apiVersion": "v1", "metadata": {}, "status": "Failure", "m
essage": "pods \"proxy\" not found", "reason": "NotFound", "details": { "name": "proxy
", "kind": "pods" }, "code": 404 }
所在位置 行:1 字符: 1
+ curl http://localhost:8001/api/v1/namespaces/default/pods/$POD_NAME:8 ...
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (System.Net.HttpWebRequest:HttpWebReq
   uest) [Invoke-WebRequest], WebException
    + FullyQualifiedErrorId : WebCmdletWebResponseException,Microsoft.PowerShell.Comm
   ands.InvokeWebRequestCommand
```

Result:

```
PS C:\Users\陈芷薇> kubectl proxy
Starting to serve on 127.0.0.1:8001
PS C:\Users\陈芷薇> curl "http://localhost:8001/api/v1/namespaces/default/pods/${POD_NAME}:8080/proxy/"

Security Warning: Script Execution Risk
Invoke-WebRequest parses the content of the web page. Script code in the web page
might be run when the page is parsed.
      RECOMMENDED ACTION:
      Use the -UseBasicParsing switch to avoid script code execution.

      Do you want to continue?

[Y] 是(Y)  [A] 全是(A)  [N] 否(N)  [L] 全否(L)  [S] 暂停(S)  [?] 帮助
(默认值为“N”):y


StatusCode        : 200
Content           : Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-658f6
                    cbd58-rfjkh | v=1

RawContent        : HTTP/1.1 200 OK
                    Audit-Id: 33911aa9-fe96-4314-aab8-4ca4a9c7bfdc
                    Transfer-Encoding: chunked
                    Cache-Control: no-cache, private
                    Content-Type: text/plain
                    Date: Sun, 14 Dec 2025 13:08:15 GMT

                    Hello Ku...
Forms             : {}
Headers           : {[Audit-Id, 33911aa9-fe96-4314-aab8-4ca4a9c7bfdc], [Transfer-Encod
                    ing, chunked], [Cache-Control, no-cache, private], [Content-Type,
```

Viewing Pods and Nodes

1. Check application configuration

1.1. Use the *kubectl get* command and look for existing Pods

1.2. View what containers are inside that Pod and what images are used to build those containers

kubectl describe pods

```
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running   0          20m
PS C:\Users\陈芷薇> kubectl describe pods
Name:             kubernetes-bootcamp-658f6cbd58-rfjkh
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Sun, 14 Dec 2025 20:52:34 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=658f6cbd58
Annotations:      <none>
Status:           Running
IP:               10.244.0.14
IPs:
  IP:           10.244.0.14
Controlled By:  ReplicaSet/kubernetes-bootcamp-658f6cbd58
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://56e7e4503ea0391a071ca209496343e7267a7484417832897
3ccda6ede131842
    Image:          gcr.io/google-samples/kubernetes-bootcamp:v1
    Image ID:       docker-pullable://gcr.io/google-samples/kubernetes-bootcam
p@sha256:0d6b8ee63bb57c5f5b6156f446b3bc3b3c143d233037f3a2f00e279c8fcc64af
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Sun, 14 Dec 2025 20:52:54 +0800
    Ready:          True
```

2. Show app in the terminal

2.1. Use the *kubectl proxy* command to run a proxy in a second terminal

2.2. Get the Pod name and query that pod directly through the proxy.

```
PS C:\Users\陈芷薇> $POD_NAME = kubectl get pods -o jsonpath="{.items[0].metad
ata.name}"
PS C:\Users\陈芷薇> echo "Name of the Pod: $POD_NAME"
Name of the Pod: kubernetes-bootcamp-658f6cbd58-rfjkh
```

2.3. See the output of our application by running curl request

Problem: PowerShell's curl (actually Invoke-WebRequest) defaults to "N/No" in the security prompt, so it cancels the request directly.

```
PS C:\Users\陈芷薇> curl "http://localhost:8001/api/v1/namespaces/default/pods
/${POD_NAME}:8080/proxy/"

Security Warning: Script Execution Risk
Invoke-WebRequest parses the content of the web page. Script code in the web
page might be run when the page is parsed.
      RECOMMENDED ACTION:
      Use the -UseBasicParsing switch to avoid script code execution.

      Do you want to continue?

[Y] 是(Y)  [A] 全是(A)  [N] 否(N)  [L] 全否(L)  [S] 暂停(S)  [?] 帮助
(默认值为“N”):
curl : Operation cancelled due to security concerns. Use -UseBasicParsing par
ameter for safe HTML parsing without script execution.
所在位置 行:1 字符: 1
+ curl "http://localhost:8001/api/v1/namespaces/default/pods/${POD_NAME ...
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : SecurityError: (http://localhos...jkh:8080/pro
   xy/:Uri) [Invoke-WebRequest], InvalidOperationException
    + FullyQualifiedErrorId : WebCmdletIEParsingDeclined,Microsoft.PowerShel
   l.Commands.InvokeWebRequestCommand
```

Solution:

```
PS C:\Users\陈芷薇> Invoke-WebRequest -UseBasicParsing "http://localhost:8001/
api/v1/namespaces/default/pods/${POD_NAME}:8080/proxy/" | Select-Object -Expan
dProperty Content
Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-658f6cbd58-rfjkh
| v=1
```

```
PS C:\Users\陈芷薇> kubectl exec "$POD_NAME" -- env
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin
HOSTNAME=kubernetes-bootcamp-658f6cbd58-rfjkh
KUBERNETES_PORT_443_TCP_PORT=443
KUBERNETES_PORT_443_TCP_ADDR=10.96.0.1
KUBERNETES_SERVICE_HOST=10.96.0.1
KUBERNETES_SERVICE_PORT=443
KUBERNETES_SERVICE_PORT_HTTPS=443
KUBERNETES_PORT=tcp://10.96.0.1:443
KUBERNETES_PORT_443_TCP=tcp://10.96.0.1:443
KUBERNETES_PORT_443_TCP_PROTO=tcp
NPM_CONFIG_LOGLEVEL=info
NODE_VERSION=6.3.1
HOME=/root
PS C:\Users\陈芷薇> kubectl exec -ti $POD_NAME -- bash
root@kubernetes-bootcamp-658f6cbd58-rfjkh:/# cat server.js
var http = require('http');
var requests=0;
var podname= process.env.HOSTNAME;
var startTime;
var host;
var handleRequest = function(request, response) {
  response.setHeader('Content-Type', 'text/plain');
  response.writeHead(200);
  response.write("Hello Kubernetes bootcamp! | Running on: ");
  response.write(host);
  response.end(" | v=1\n");
  console.log("Running On:" ,host, "| Total Requests:", ++requests,"| App Upti
me:", (new Date() - startTime)/1000 , "seconds", "| Log Time:",new Date());
}
```

```
root@kubernetes-bootcamp-658f6cbd58-rfjkh:/# curl http://localhost:8080
Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-658f6cbd58-rfjkh
| v=1
```

Using a Service to Expose Your App

1. Create a new service

1.1. Verify that our application is running by the *kubectl get* command to look for existing Pods

1.2. List the current Services from our cluster

kubectl get services

1.3. Expose the deployment to external traffic

kubectl expose deployment/kubernetes-bootcamp --type="NodePort" --port 8080

1.4. Find out what port was opened externally

kubectl describe services/kubernetes-bootcamp

```
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running   0          3h
PS C:\Users\陈芷薇> kubectl get services
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   58d
PS C:\Users\陈芷薇> kubectl expose deployment/kubernetes-bootcamp --type="Node
Port" --port 8080
service/kubernetes-bootcamp exposed
PS C:\Users\陈芷薇> kubectl describe services/kubernetes-bootcamp
Name:                     kubernetes-bootcamp
Namespace:                default
Labels:                   app=kubernetes-bootcamp
Annotations:              <none>
Selector:                 app=kubernetes-bootcamp
Type:                     NodePort
IP Family Policy:         SingleStack
IP Families:              IPv4
IP:                       10.98.158.124
IPs:                      10.98.158.124
Port:                     <unset>  8080/TCP
TargetPort:               8080/TCP
NodePort:                 <unset>  30846/TCP
Endpoints:                10.244.0.14:8080
Session Affinity:         None
External Traffic Policy:  Cluster
Internal Traffic Policy:  Cluster
Events:                   <none>
```

1.5. Create an environment variable called NODE_PORT that has the value of the Node port assigned

$NODE_PORT = kubectl get service Kubernetes-bootcamp -o js onpath=".spec.ports[0].nodePort)"

$MINIKUBE_IP = minikube ip

```
PS C:\Users\陈芷薇> $NODE_PORT = kubectl get service kubernetes-bootcamp -o js
onpath="{.spec.ports[0].nodePort}"
PS C:\Users\陈芷薇> echo "NODE_PORT=$NODE_PORT"
NODE_PORT=30846
PS C:\Users\陈芷薇> $MINIKUBE_IP = minikube ip
```

1.6. Test that the app is exposed outside of the cluster using *curl*

curl http://"$(MINIKUBE_IP):$NODE_PORT"

```
PS C:\Users\陈芷薇> curl "http://${MINIKUBE_IP}:${NODE_PORT}"
curl : 无法连接到远程服务器
所在位置 行:1 字符: 1
+ curl "http://${MINIKUBE_IP}:${NODE_PORT}"
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (System.Net.HttpWebRequest:H
   ttpWebRequest) [Invoke-WebRequest], WebException
    + FullyQualifiedErrorId : WebCmdletWebResponseException,Microsoft.PowerS
   hell.Commands.InvokeWebRequestCommand
```

This is because containers inside Docker Desktop are isolated from my host computer. So if I am running minikube with Docker Desktop as the container driver, a minikube tunnel is needed. Open a separate terminal window, execute *minikube service kubernetes-bootcamp –url.*

```
PS C:\Users\陈芷薇> minikube service kubernetes-bootcamp --url
http://127.0.0.1:58046
! 因为你正在使用 windows 上的 Docker 驱动程序，所以需要打开终端才能运行它。
```

Then use the given URL to access the app.

curl 127.0.0.1:58046

```
PS C:\Users\陈芷薇> curl 127.0.0.1:58046

Security Warning: Script Execution Risk
Invoke-WebRequest parses the content of the web page. Script code in the web
page might be run when the page is parsed.
      RECOMMENDED ACTION:
      Use the -UseBasicParsing switch to avoid script code execution.

      Do you want to continue?

[Y] 是(Y)  [A] 全是(A)  [N] 否(N)  [L] 全否(L)  [S] 暂停(S)  [?] 帮助
(默认值为“N”):y


StatusCode        : 200
StatusDescription : OK
Content           : Hello Kubernetes bootcamp! | Running on: kubernetes-bootc
                    amp-658f6cbd58-rfjkh | v=1

RawContent        : HTTP/1.1 200 OK
                    Connection: keep-alive
                    Transfer-Encoding: chunked
                    Content-Type: text/plain
                    Date: Sun, 14 Dec 2025 15:57:14 GMT

                    Hello Kubernetes bootcamp! | Running on: kubernetes-bootc
                    amp-658f6...
Forms             : {}
```

Analysis: When using the Minikube Docker driver on Windows, NodePort may not be directly accessible from the host via `minikube ip:nodePort` because this IP belongs to the Docker internal network. In this case, you should use `minikube service <svc> --url` to obtain the access address

mapped to `127.0.0.1:<port>`, or use `kubectl port-forward` to forward the service to the local port. Accessing `http://127.0.0.1:<port>` returns a 200 OK response, proving that the application has been successfully exposed to the outside of the cluster (host side).

2. Using labels

2.1. See the name (the *key*) of that label that created by Deployment for our pod

kubectl describe deployment

```
PS C:\Users\陈芷薇> kubectl describe deployment
Name:                   kubernetes-bootcamp
Namespace:              default
CreationTimestamp:      Sun, 14 Dec 2025 20:52:34 +0800
Labels:                 app=kubernetes-bootcamp
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               app=kubernetes-bootcamp
Replicas:               1 desired | 1 updated | 1 total | 1 available | 0 unav
ailable
StrategyType:           RollingUpdate
MinReadySeconds:        0
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=kubernetes-bootcamp
  Containers:
   kubernetes-bootcamp:
    Image:         gcr.io/google-samples/kubernetes-bootcamp:v1
    Port:          <none>
    Host Port:     <none>
    Environment:   <none>
    Mounts:        <none>
  Volumes:         <none>
  Node-Selectors:  <none>
  Tolerations:     <none>
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Available      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
```

2.2. Use this label to query our list of Pods

kubectl get pods -l app=kubernetes-bootcamp

2.3. List the existing Services

kubectl get services -l app=kubernetes-bootcamp

```
PS C:\Users\陈芷薇> kubectl get pods -l app=kubernetes-bootcamp
NAME                                  READY   STATUS    RESTARTS   AGE
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running   0          3h14m
PS C:\Users\陈芷薇> kubectl get services -l app=kubernetes-bootcamp
NAME                  TYPE       CLUSTER-IP      EXTERNAL-IP   PORT(S)
  AGE
kubernetes-bootcamp   NodePort   10.98.158.124   <none>        8080:30846/TCP
  14m
```

2.4. Get the name of the Pod and store it in the POD_NAME environment variable

$POD_NAME = kubectl get pods -o jsonpath=”{.items[0].metadata.name}”

2.5. Use the label subcommand followed by the object type to apply a new label

kubectl label pods "$POD_NAME" version=v1

2.6. Check it with the *describe pod* command

```
PS C:\Users\陈芷薇> $POD_NAME = kubectl get pods -o jsonpath="{.items[0].metad
ata.name}"
PS C:\Users\陈芷薇> echo "Name of the Pod: $POD_NAME"
Name of the Pod: kubernetes-bootcamp-658f6cbd58-rfjkh
PS C:\Users\陈芷薇> kubectl label pods "$POD_NAME" version=v1
pod/kubernetes-bootcamp-658f6cbd58-rfjkh labeled
PS C:\Users\陈芷薇> kubectl describe pods "$POD_NAME"
Name:             kubernetes-bootcamp-658f6cbd58-rfjkh
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Sun, 14 Dec 2025 20:52:34 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=658f6cbd58
                  version=v1
Annotations:      <none>
Status:           Running
IP:               10.244.0.14
IPs:
  IP:           10.244.0.14
Controlled By:  ReplicaSet/kubernetes-bootcamp-658f6cbd58
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://56e7e4503ea0391a071ca209496343e7267a7484417832897
3ccda6ede131842
    Image:          gcr.io/google-samples/kubernetes-bootcamp:v1
    Image ID:       docker-pullable://gcr.io/google-samples/kubernetes-bootcam
p@sha256:0d6b8ee63bb57c5f5b6156f446b3bc3b3c143d233037f3a2f00e279c8fcc64af
    Port:           <none>
```

3. Delete a service

3.1. delete Services

kubectl delete service -l app=kubernetes-bootcamp

3.2. Confirm that the Service is gone

kubectl get services

```
PS C:\Users\陈芷薇> kubectl get services
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   58d
```

3.3. Use curl the previously exposed IP and port to confirm that route is not exposed anymore

curl 127.0.0.1:58046

```
PS C:\Users\陈芷薇> curl 127.0.0.1:58046
curl : 无法连接到远程服务器
所在位置 行:1 字符: 1
+ curl 127.0.0.1:58046
+ ~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : InvalidOperation: (System.Net.HttpWebRequest:HttpW
   ebRequest) [Invoke-WebRequest], WebException
    + FullyQualifiedErrorId : WebCmdletWebResponseException,Microsoft.PowerShell
   .Commands.InvokeWebRequestCommand
```

3.4. Confirm that the app is still running with a curl from inside the pod

kubectl exec -ti $POD_NAME -- curl http://localhost:8080

Here that the application is up. This is because the Deployment is managing the application. To shut down the application, the Deployment is needed to be deleted.

```
PS C:\Users\陈芷薇> kubectl exec -ti $POD_NAME -- curl http://localhost:8080
Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-658f6cbd58-rfjkh | v=
1
```

Running Multiple Instances of Your App

1. Create a new Service with its type set to LoadBalancer

```
PS C:\Users\陈芷薇> kubectl expose deployment/kubernetes-bootcamp --type="LoadBala
ncer" --port 8080
service/kubernetes-bootcamp exposed
```

2. Scaling a Deployment

2.1. List my Deployments

kubectl get deployments

This shows:

- *NAME* lists the names of the Deployments in the cluster.
- *READY* shows the ratio of CURRENT/DESIRED replicas
- *UP-TO-DATE* displays the number of replicas that have been updated to achieve the desired state.
- *AVAILABLE* displays how many replicas of the application are available to your users.
- *AGE* displays the amount of time that the application has been running.

```
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   1/1     1            1           3h22m
```

2.2. See the ReplicaSet created by the Deployment

kubectl get rs

Notice that the name of the ReplicaSet is always formatted as [DEPLOYMENT-NAME]-[RANDOM-STRING]. The random string is randomly generated and uses the pod-template-hash as a seed. DESIRED displays the desired number of replicas of the application, which you define when you create the Deployment. This is the desired state. *CURRENT* displays how many replicas are currently running.

2.3. Scale the Deployment to 4 replicas

kubectl scale deployments/kubernetes-bootcamp --replicas=4

2.4. List the Deployment

kubectl get deployments

2.5. Check if the number of Pods changed

kubectl get pods -o wide

```
PS C:\Users\陈芷薇> kubectl get rs
NAME                            DESIRED   CURRENT   READY   AGE
kubernetes-bootcamp-658f6cbd58   1         1         1       3h22m
PS C:\Users\陈芷薇> kubectl scale deployments/kubernetes-bootcamp --replicas=4
deployment.apps/kubernetes-bootcamp scaled
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   4/4     4            4           3h23m
PS C:\Users\陈芷薇> kubectl get pods -o wide
NAME                                   READY   STATUS    RESTARTS   AGE     IP
       NODE       NOMINATED NODE   READINESS GATES
kubernetes-bootcamp-658f6cbd58-9btk8   1/1     Running   0          15s     10.244
.0.17   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-fqcmn   1/1     Running   0          15s     10.244
.0.15   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-kv77h   1/1     Running   0          15s     10.244
.0.16   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running   0          3h23m   10.244
.0.14   minikube   <none>           <none>
```

2.6. Check the changes of Pods in the Deployment events log

kubectl describe deployments/kubernetes-bootcamp

```
PS C:\Users\陈芷薇> kubectl describe deployments/kubernetes-bootcamp
Name:                   kubernetes-bootcamp
Namespace:              default
CreationTimestamp:      Sun, 14 Dec 2025 20:52:34 +0800
Labels:                 app=kubernetes-bootcamp
Annotations:            deployment.kubernetes.io/revision: 1
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=kubernetes-bootcamp
  Containers:
   kubernetes-bootcamp:
    Image:         gcr.io/google-samples/kubernetes-bootcamp:v1
    Port:          <none>
    Host Port:     <none>
    Environment:   <none>
    Mounts:        <none>
  Volumes:         <none>
  Node-Selectors:  <none>
  Tolerations:     <none>
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Progressing    True    NewReplicaSetAvailable
  Available      True    MinimumReplicasAvailable
OldReplicaSets:  <none>
NewReplicaSet:   kubernetes-bootcamp-658f6cbd58 (4/4 replicas created)
Events:
  Type    Reason             Age   From                   Message
  ----    ------             ----  ----                   -------
  Normal  ScalingReplicaSet  36s   deployment-controller  Scaled up replica set kubernetes-bootcamp-658f6cbd58 from 1 to 4
```

3. Load balancing

3.1. Use *describe service* to find out the exposed IP and Port

```
PS C:\Users\陈芷薇> kubectl describe services/kubernetes-bootcamp
Name:                     kubernetes-bootcamp
Namespace:                default
Labels:                   app=kubernetes-bootcamp
Annotations:              <none>
Selector:                 app=kubernetes-bootcamp
Type:                     LoadBalancer
IP Family Policy:         SingleStack
IP Families:              IPv4
IP:                       10.101.171.196
IPs:                      10.101.171.196
Port:                     <unset>  8080/TCP
TargetPort:               8080/TCP
NodePort:                 <unset>  30723/TCP
Endpoints:                10.244.0.14:8080,10.244.0.17:8080,10.244.0.15:8080 + 1 m
ore...
Session Affinity:         None
External Traffic Policy:  Cluster
Internal Traffic Policy:  Cluster
Events:                   <none>
```

3.2. Open a minikube tunnel in a separate terminal window

minikube service kubernetes-bootcamp --url

```
PS C:\Users\陈芷薇> minikube service kubernetes-bootcamp --url
http://127.0.0.1:56169
! 因为你正在使用 windows 上的 Docker 驱动程序，所以需要打开终端才能运行它。
```

3.3. Curl to the exposed IP address and port.

curl 127.0.0.1:51082

```
PS C:\Users\陈芷薇> curl http://127.0.0.1:56169

Security Warning: Script Execution Risk
Invoke-WebRequest parses the content of the web page. Script code in the web page
 might be run when the page is parsed.
      RECOMMENDED ACTION:
      Use the -UseBasicParsing switch to avoid script code execution.

      Do you want to continue?

[Y] 是(Y)  [A] 全是(A)  [N] 否(N)  [L] 全否(L)  [S] 暂停(S)  [?] 帮助
(默认值为“N”):y


StatusCode        : 200
StatusDescription : OK
Content           : Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-
                    658f6cbd58-9btk8 | v=1

RawContent        : HTTP/1.1 200 OK
                    Connection: keep-alive
                    Transfer-Encoding: chunked
                    Content-Type: text/plain
                    Date: Sun, 14 Dec 2025 16:18:14 GMT

                    Hello Kubernetes bootcamp! | Running on: kubernetes-bootcamp-
                    658f6...
Forms             : {}
Headers           : {[Connection, keep-alive], [Transfer-Encoding, chunked], [Con
```

4. Scale down

4.1. Scale down the Deployment to 2 replicas

kubectl scale deployments/kubernetes-bootcamp --replicas=2

4.2. List the Deployments to check if the change was applied with the *get deployments* subcommand

4.3. List the number of Pods, with *get pods*

```
PS C:\Users\陈芷薇> kubectl scale deployments/kubernetes-bootcamp --replicas=2
deployment.apps/kubernetes-bootcamp scaled
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   2/2     2            2           3h26m
PS C:\Users\陈芷薇> kubectl get pods -o wide
NAME                                  READY   STATUS        RESTARTS   AGE     IP
            NODE       NOMINATED NODE   READINESS GATES
kubernetes-bootcamp-658f6cbd58-9btk8   1/1     Terminating   0          3m45s   10
.244.0.17   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-fqcmn   1/1     Terminating   0          3m45s   10
.244.0.15   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-kv77h   1/1     Running       0          3m45s   10
.244.0.16   minikube   <none>           <none>
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running       0          3h26m   10
.244.0.14   minikube   <none>           <none>
```

Performing a Rolling Update

1. Update the version of the app

1.1. List my Deployments

kubectl get deployments

1.2. List the running Pods

kubectl get pods

1.3. View the current image version of the app

kubectl describe pods

```
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   2/2     2            2           3h27m
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
kubernetes-bootcamp-658f6cbd58-kv77h   1/1     Running   0          5m7s
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running   0          3h28m
PS C:\Users\陈芷薇> kubectl describe pods
Name:             kubernetes-bootcamp-658f6cbd58-kv77h
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Mon, 15 Dec 2025 00:15:35 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=658f6cbd58
Annotations:      <none>
Status:           Running
IP:               10.244.0.16
IPs:
  IP:           10.244.0.16
Controlled By:  ReplicaSet/kubernetes-bootcamp-658f6cbd58
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://e73d1af10ada663e1d27a9d84e7c0ce1a020fb5c2c8b5655ffaa0
59076607326
    Image:          gcr.io/google-samples/kubernetes-bootcamp:v1
    Image ID:       docker-pullable://gcr.io/google-samples/kubernetes-bootcamp@sh
a256:0d6b8ee63bb57c5f5b6156f446b3bc3b3c143d233037f3a2f00e279c8fcc64af
    Port:           <none>
```

1.4. Update the image of the application to version 2

kubectl set image deployments/kubernetes-bootcamp kubernetes-bootcamp=docker.io/jocatalin/kubernetes-bootcamp:v2

1.5. Check the status of the new Pods, and view the old one terminating with the get pods subcommand

```
PS C:\Users\陈芷薇> kubectl set image deployments/kubernetes-bootcamp kubernetes-b
ootcamp=docker.io/jocatalin/kubernetes-bootcamp:v2
deployment.apps/kubernetes-bootcamp image updated
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS              RESTARTS   AGE
kubernetes-bootcamp-57cc954bb9-d2mml   0/1     ContainerCreating   0          6s
kubernetes-bootcamp-658f6cbd58-kv77h   1/1     Running             0          6m7s
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Running             0          3h29
m
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS        RESTARTS   AGE
kubernetes-bootcamp-57cc954bb9-d2mml   1/1     Running       0          16s
kubernetes-bootcamp-57cc954bb9-xlmr7   1/1     Running       0          6s
kubernetes-bootcamp-658f6cbd58-kv77h   1/1     Terminating   0          6m17s
kubernetes-bootcamp-658f6cbd58-rfjkh   1/1     Terminating   0          3h29m
```

2. verify an update

2.1. Confirm the update by running the *rollout status* subcommand

2.2. View the current image version of the app

kubectl describe pods

```
PS C:\Users\陈芷薇> kubectl rollout status deployments/kubernetes-bootcamp
deployment "kubernetes-bootcamp" successfully rolled out
PS C:\Users\陈芷薇> kubectl describe pods
Name:             kubernetes-bootcamp-57cc954bb9-d2mml
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Mon, 15 Dec 2025 00:21:36 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=57cc954bb9
Annotations:      <none>
Status:           Running
IP:               10.244.0.18
IPs:
  IP:           10.244.0.18
Controlled By:  ReplicaSet/kubernetes-bootcamp-57cc954bb9
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://1485dd691a84e4925ce8e92753861083f951f9cb5d4adfa13c9bc
cb3c3335474
    Image:          docker.io/jocatalin/kubernetes-bootcamp:v2
    Image ID:       docker-pullable://jocatalin/kubernetes-bootcamp@sha256:fb1a3ce
d00cecfc1f83f18ab5cd14199e30adc1b49aa4244f5d65ad3f5feb2a5
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Mon, 15 Dec 2025 00:21:45 +0800
    Ready:          True
    Restart Count:  0
```

3. Roll back an update

3.1. Deploy an image tagged with v10

kubectl set image deployments/kubernetes-bootcamp kubernetes-bootcamp=gcr.io/google-samples/kubernetes-bootcamp:v10

3.2. Use *get deployments* to see the status of the deployment

3.3. Run the *get pods* subcommand to list all Pods

```
PS C:\Users\陈芷薇> kubectl set image deployments/kubernetes-bootcamp kubernetes-b
ootcamp=gcr.io/google-samples/kubernetes-bootcamp:v10
deployment.apps/kubernetes-bootcamp image updated
PS C:\Users\陈芷薇> kubectl get deployments
NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
kubernetes-bootcamp   2/2     1            2           3h33m
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS         RESTARTS   AGE
kubernetes-bootcamp-57cc954bb9-d2mml  1/1     Running        0          4m34s
kubernetes-bootcamp-57cc954bb9-xlmr7  1/1     Running        0          4m24s
kubernetes-bootcamp-677ff875c4-qbgpv  0/1     ErrImagePull   0          15s
```

3.4. Get more insight into the problem about ImagePullBackOff

kubectl describe pods

```
PS C:\Users\陈芷薇> kubectl describe pods
Name:             kubernetes-bootcamp-57cc954bb9-d2mml
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Mon, 15 Dec 2025 00:21:36 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=57cc954bb9
Annotations:      <none>
Status:           Running
IP:               10.244.0.18
IPs:
  IP:           10.244.0.18
Controlled By:  ReplicaSet/kubernetes-bootcamp-57cc954bb9
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://1485dd691a84e4925ce8e92753861083f951f9cb5d4adfa13c9bc
cb3c3335474
    Image:          docker.io/jocatalin/kubernetes-bootcamp:v2
    Image ID:       docker-pullable://jocatalin/kubernetes-bootcamp@sha256:fb1a3ce
d00cecfc1f83f18ab5cd14199e30adc1b49aa4244f5d65ad3f5feb2a5
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Mon, 15 Dec 2025 00:21:45 +0800
    Ready:          True
    Restart Count:  0
    Environment:    <none>
Containers:
  kubernetes-bootcamp:
    Container ID:
    Image:          gcr.io/google-samples/kubernetes-bootcamp:v10
    Image ID:
    Port:           <none>
    Host Port:      <none>
    State:          Waiting
      Reason:       ImagePullBackOff
    Ready:          False
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-5vcfn (ro
)
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  35s                default-scheduler  Successfully assigned
default/kubernetes-bootcamp-677ff875c4-qbgpv to minikube
  Normal   BackOff    30s                kubelet            Back-off pulling image
 "gcr.io/google-samples/kubernetes-bootcamp:v10"
  Warning  Failed     30s                kubelet            Error: ImagePullBackOf
f
  Normal   Pulling    17s (x2 over 35s)  kubelet            Pulling image "gcr.io/
google-samples/kubernetes-bootcamp:v10"
  Warning  Failed     12s (x2 over 30s)  kubelet            Failed to pull image "
gcr.io/google-samples/kubernetes-bootcamp:v10": Error response from daemon: manife
st for gcr.io/google-samples/kubernetes-bootcamp:v10 not found: manifest unknown:
Failed to fetch "v10"
  Warning  Failed     12s (x2 over 30s)  kubelet            Error: ErrImagePull
```

In the Events section of the output for the affected Pods, notice that the v10 image version did not exist in the repository.

3.5. Roll back the deployment to the last working version

kubectl rollout undo deployments/kubernetes-bootcamp

The rollout undo command reverts the deployment to the previous known state (v2 of the image).

3.6. List the Pods

kubectl get pods

3.7. Check the image deployed on the running Pods

kubectl describe pods

3.8. Clean up the local cluster

kubectl delete deployments/kubernetes-bootcamp services/kubernetes-bootcamp

```
PS C:\Users\陈芷薇> kubectl rollout undo deployments/kubernetes-bootcamp
deployment.apps/kubernetes-bootcamp rolled back
PS C:\Users\陈芷薇> kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
kubernetes-bootcamp-57cc954bb9-d2mml   1/1     Running   0          8m44s
kubernetes-bootcamp-57cc954bb9-xlmr7   1/1     Running   0          8m34s
PS C:\Users\陈芷薇> kubectl describe pods
Name:             kubernetes-bootcamp-57cc954bb9-d2mml
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Mon, 15 Dec 2025 00:21:36 +0800
Labels:           app=kubernetes-bootcamp
                  pod-template-hash=57cc954bb9
Annotations:      <none>
Status:           Running
IP:               10.244.0.18
IPs:
  IP:           10.244.0.18
Controlled By:  ReplicaSet/kubernetes-bootcamp-57cc954bb9
Containers:
  kubernetes-bootcamp:
    Container ID:   docker://1485dd691a84e4925ce8e92753861083f951f9cb5d4adfa13c9bc
cb3c3335474
    Image:          docker.io/jocatalin/kubernetes-bootcamp:v2
    Image ID:       docker-pullable://jocatalin/kubernetes-bootcamp@sha256:fb1a3ce
d00cecfc1f83f18ab5cd14199e30adc1b49aa4244f5d65ad3f5feb2a5

Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  8m40s  default-scheduler  Successfully assigned default/kuber
netes-bootcamp-57cc954bb9-xlmr7 to minikube
  Normal  Pulled     8m40s  kubelet            Container image "docker.io/jocatali
n/kubernetes-bootcamp:v2" already present on machine
  Normal  Created    8m40s  kubelet            Created container: kubernetes-bootc
amp
  Normal  Started    8m40s  kubelet            Started container kubernetes-bootca
mp
PS C:\Users\陈芷薇> kubectl delete deployments/kubernetes-bootcamp services/kubern
etes-bootcamp
deployment.apps "kubernetes-bootcamp" deleted from default namespace
service "kubernetes-bootcamp" deleted from default namespace
```