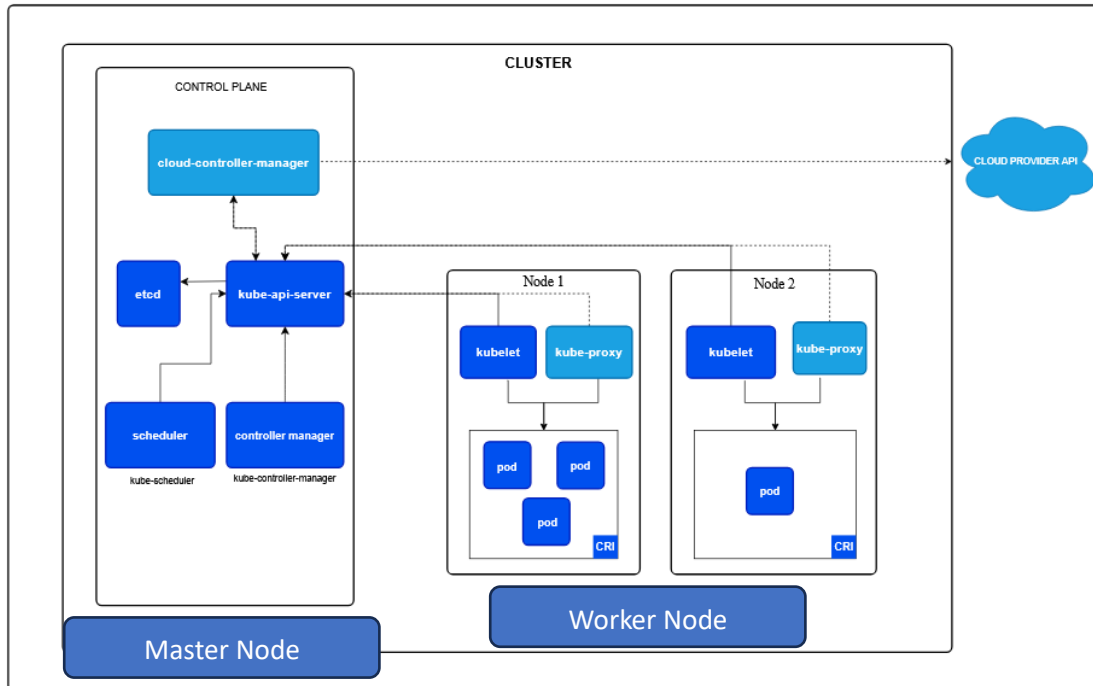


Chapitre 5 – Kubernetes : plateforme de déploiement des applications conteneurisées

Conçu par Google, Kubernetes (Timonier) ou K8s est un système d'orchestration de conteneurs et non pas un logiciel permettant le lancement de conteneurs. Il a donc besoin de docker ou d'un autre logiciel permettant de créer des conteneurs.

Architecture du cluster Kubernetes :

<https://kubernetes.io/fr/docs/concepts/architecture/>



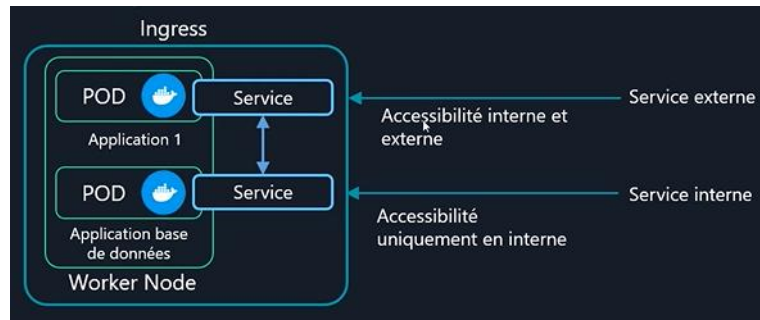
Les composants (objets) :



Les composants services internes et externes :



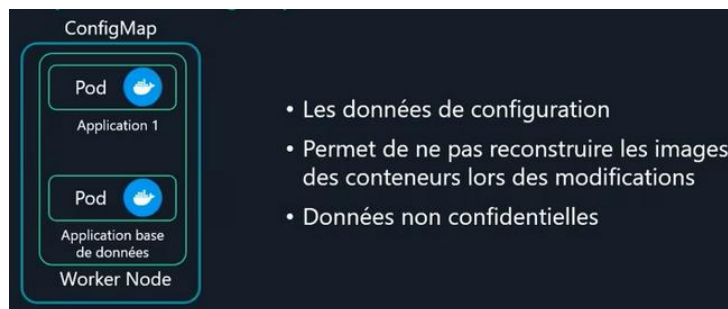
L'objet Ingress :



L'objet Ingress permet d'utiliser des url avec des noms de domaine.

Les cycles de vie entre les pods et les services sont complètement indépendants.

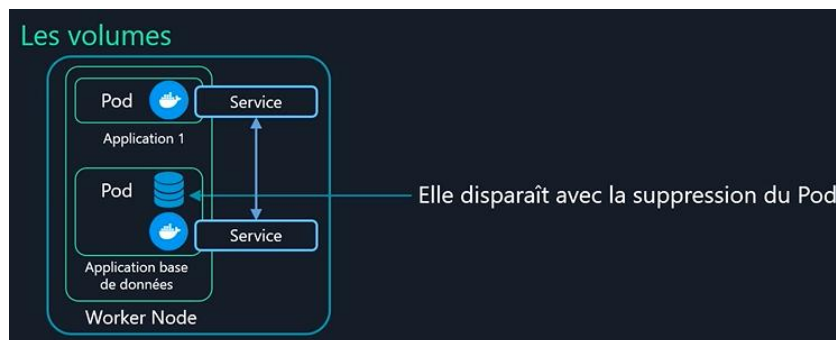
L'objet ConfigMap :

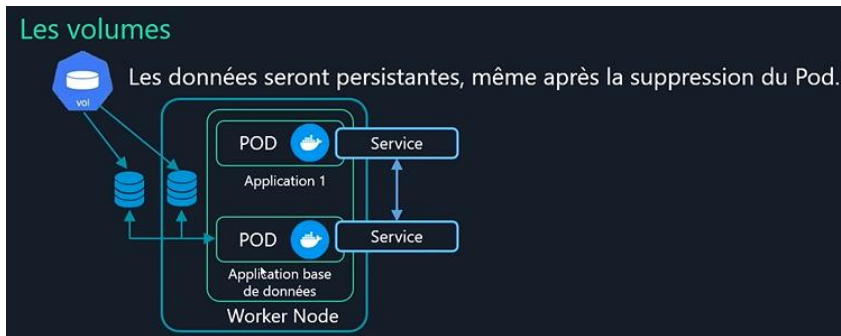


L'objet Secret :

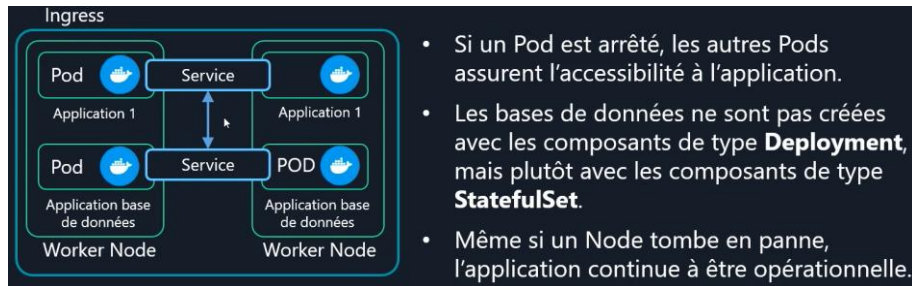


Les volumes :





Le déploiement : manière dont on veut souhaiter déployer l'application



Créer un cluster Kubernetes Local pour l'apprentissage :

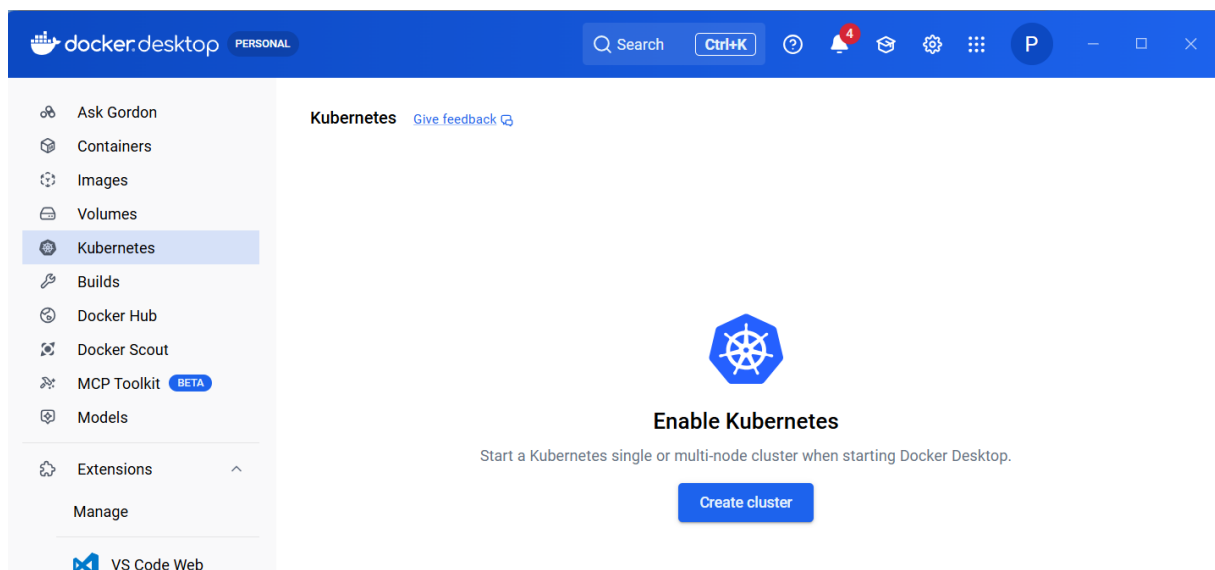
- Minikube ;
- Kind ;
- K3s.

Choisir Minikube est le meilleur choix car :

- Environnement très proche de la production ;
- Permet de tester la haute disponibilité ;
- Nombreux Add-ons disponibles tels que dashboard, metrics, ingress.

En fonction du driver choisi, chaque nœud est soit un conteneur soit une VM.

1. Kubernetes avec Docker Desktop.



Create Kubernetes Cluster



Cluster Type

Kubeadm
Create a single-node cluster with kubeadm.
Version: v1.34.1

kind
Create a cluster containing one or more nodes with kind. Requires the [containerd image store](#)

Advanced Settings

Show system containers (advanced)
Show Kubernetes internal containers when using Docker commands.

Cancel

Create

Create Kubernetes Cluster



Cluster Type

Kubeadm
Create a single-node cluster with kubeadm.
Version: v1.34.1

kind
Create a cluster containing one or more nodes with kind. Requires the [containerd image store](#)

Node(s): 2

Changing the number of nodes resets the cluster. All stacks and resources are deleted.



Version: 1.31.1

Changing the Kubernetes version resets your cluster. All stacks and resources are deleted.

Kubernetes version
1.31.1

Advanced Settings

Show system containers (advanced)
Show Kubernetes internal containers when using Docker commands.

Cancel

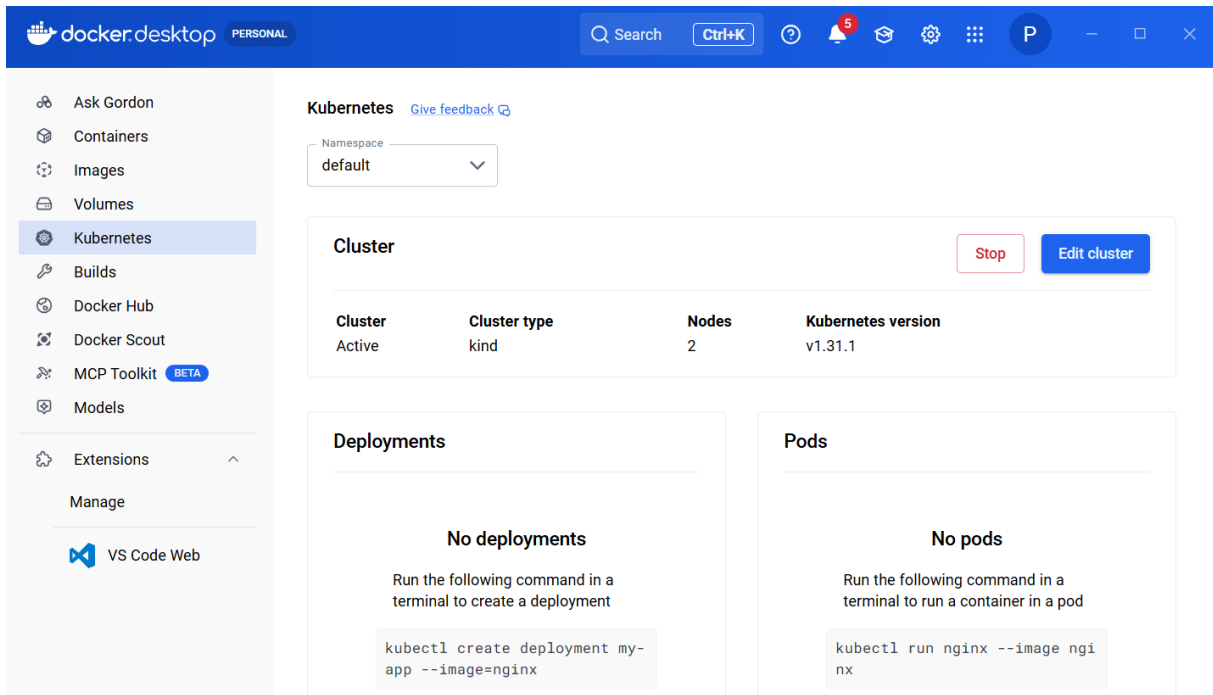
Create

Kubernetes Cluster Installation

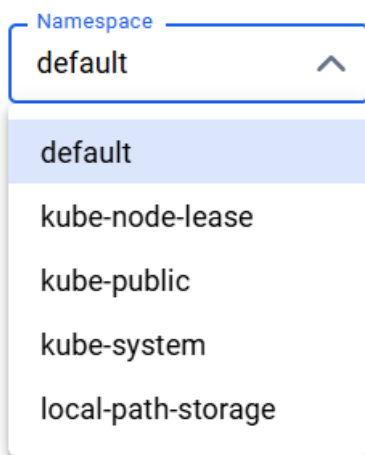
Installation takes a few minutes and requires an internet connection.

Cancel

Install



Kubernetes [Give feedback](#)



2 nœuds : un maître et un worker

```

Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Installez la dernière version de PowerShell pour de nouvelles fonctionnalités
et améliorations ! https://aka.ms/PSWindows

PS C:\Users\phbou> kubectl get nodes
NAME                                STATUS    ROLES    AGE     VERSION
desktop-control-plane              Ready    control-plane   9m5s    v1.31.1
desktop-worker                      Ready    <none>         8m51s    v1.31.1
PS C:\Users\phbou> |

```

Modify Kubernetes Cluster



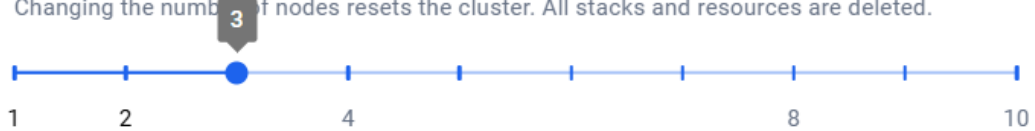
Cluster Type

Kubeadm
Create a single-node cluster with kubeadm.
Version: v1.34.1

kind
Create a cluster containing one or more nodes with kind. Requires the [containerd image store](#)

Node(s): 3

Changing the number of nodes resets the cluster. All stacks and resources are deleted.



Version: 1.31.1

Changing the Kubernetes version resets your cluster. All stacks and resources are deleted.

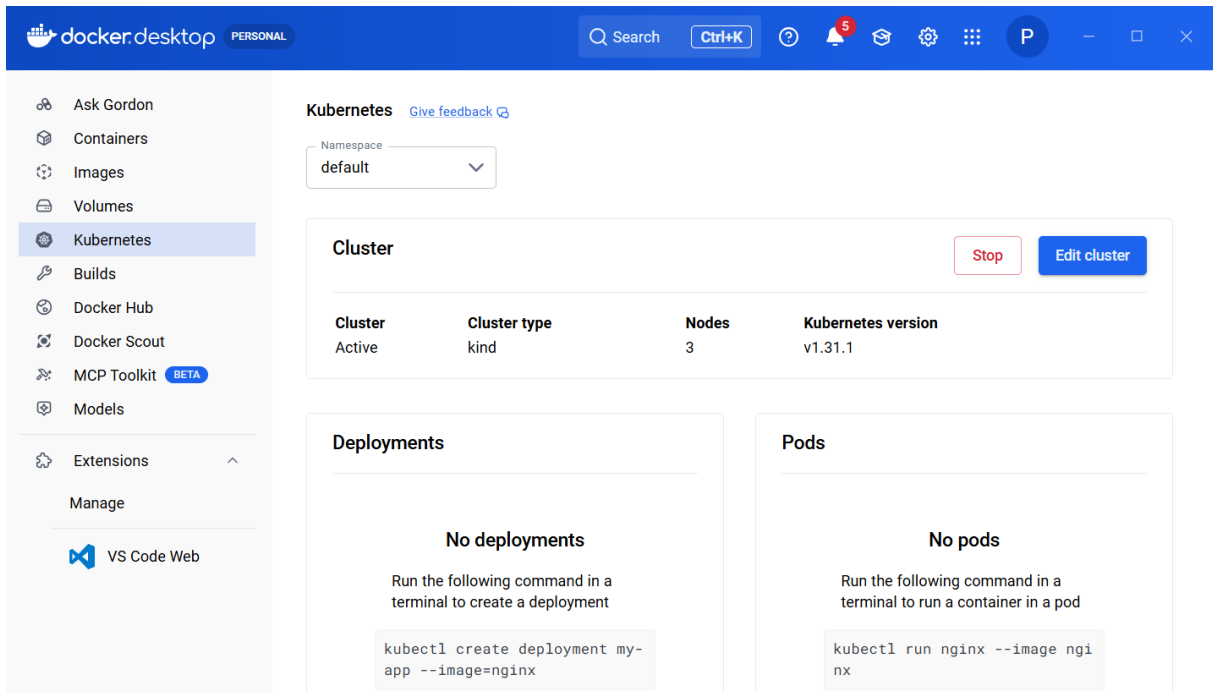
Kubernetes version

Advanced Settings

Show system containers (advanced)
Show Kubernetes internal containers when using Docker commands.

Change Kubernetes cluster configuration?

Changing the number of nodes deletes the current cluster and creates a new one.

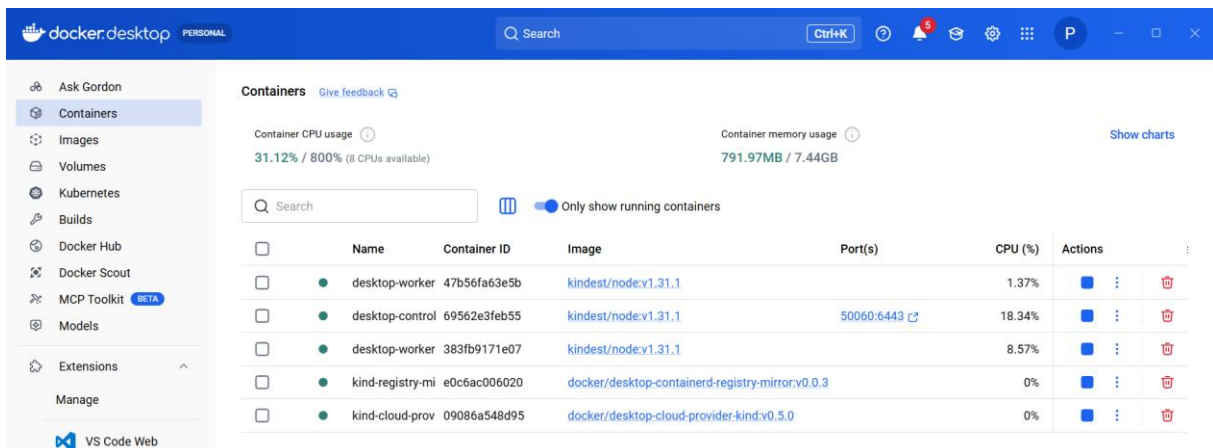


Un maître et 2 workers :

```

Windows PowerShell
PS C:\Users\phbou> kubectl get nodes
NAME                STATUS    ROLES    AGE   VERSION
desktop-control-plane Ready    control-plane 104s  v1.31.1
desktop-worker      Ready    <none>    88s   v1.31.1
desktop-worker2     Ready    <none>    88s   v1.31.1
PS C:\Users\phbou>

```



2. Installation de Minikube.

1) Activer la fonctionnalité Windows Hyper-V :



2) Installer Minikube

<https://minikube.sigs.k8s.io/docs/start/?arch=%2Fwindows%2Fx86-64%2Fstable%2F.exe+download>

minikube start

minikube is local Kubernetes, focusing on making it easy to learn and develop for Kubernetes.

All you need is Docker (or similarly compatible) container or a Virtual Machine environment, and Kubernetes is a single command away: `minikube start`

What you'll need

- 2 CPUs or more
- 2GB of free memory
- 20GB of free disk space
- Internet connection
- Container or virtual machine manager, such as: [Docker](#), [QEMU](#), [Hyperkit](#), [Hyper-V](#), [KVM](#), [Parallels](#), [Podman](#), [VirtualBox](#), or [VMware Fusion/Workstation](#)

1 Installation

Click on the buttons that describe your target platform. For other architectures, see [the release page](#) for a complete list of minikube binaries.

Operating system	Linux	macOS	Windows	Try in Browser
Architecture	x86-64			
Release type	Stable			
Installer type	.exe download	Windows Package Manager	Chocolatey	

To install the latest minikube **stable** release on **x86-64 Windows** using **.exe download**:

1. Download and run the installer for the [latest release](#).

Or if using PowerShell, use this command:

```
New-Item -Path 'c:\' -Name 'minikube' -ItemType Directory -Force  
$ProgressPreference = 'SilentlyContinue'; Invoke-WebRequest -OutFile 'c:\minikube\minikube.exe' -Uri 'https://github.com/kuber
```

[Copy](#)

2. Add the minikube.exe binary to your PATH.

Make sure to run PowerShell as Administrator.

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

If you used a terminal (like powershell) for the installation, please close the terminal and reopen it before running minikube.

```
Administrateur : Windows Po... x + v - □ ×  
Windows PowerShell  
Copyright (C) Microsoft Corporation. Tous droits réservés.  
  
Installez la dernière version de PowerShell pour de nouvelles fonctionnalités et améliorations ! https://aka.ms/PSWindow  
s  
PS C:\Users\phbou> New-Item -Path 'c:\' -Name 'minikube' -ItemType Directory -Force  
  
Répertoire : C:\  
  
Mode                LastWriteTime         Length Name  
----                -  
d-----          24/04/2026   11:45         minikube  
  
PS C:\Users\phbou> $ProgressPreference = 'SilentlyContinue'; Invoke-WebRequest -OutFile 'c:\minikube\minikube.exe' -Uri  
'https://github.com/kubernetes/minikube/releases/latest/download/minikube-windows-amd64.exe' -UseBasicParsing  
PS C:\Users\phbou> |
```

```
Administrateur : Windows Po... x + v - □ ×  
PS C:\Users\phbou> $oldPath = [Environment]::GetEnvironmentVariable('Path', [EnvironmentVariableTarget]::Machine)  
PS C:\Users\phbou> if ($oldPath.Split(';') -notcontains 'C:\minikube'){  
>> [Environment]::SetEnvironmentVariable('Path', $('{};C:\minikube' -f $oldPath), [EnvironmentVariableTarget]::Machin  
e)  
>> }  
>> }  
PS C:\Users\phbou> |
```

```

Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Installez la dernière version de PowerShell pour de nouvelles fonctionnalités et améliorations : https://aka.ms/PSWindows
S

PS C:\Users\phbou> minikube start
minikube v1.38.1 sur Microsoft Windows 11 Enterprise 25H2
* Choix automatique du pilote hyperv. Autres choix: virtualbox, ssh
! Starting v1.39.0, minikube will default to "containerd" container runtime. See #21973 for more info.
* Téléchargement de l'image de démarrage de la VM...
> minikube-v1.38.0-amd64.iso...: 65 B / 65 B [-----] 100.00% ? p/s 0s
> minikube-v1.38.0-amd64.iso: 370.55 MiB / 370.55 MiB 100.00% 1.33 MiB p/
* Démarrage du nœud "minikube" primary control-plane dans le cluster "minikube"
* Téléchargement du préchargement de Kubernetes v1.35.1...
> preloaded-images-k8s-v18-v1...: 272.45 MiB / 272.45 MiB 100.00% 1.16 Mi
* Création de VM hyperv (CPUs=2, Mémoire=4000MB, Disque=20000MB)...
* Préparation de Kubernetes v1.35.1 sur Docker 28.5.2...
* Configuration de bridge CNI (Container Networking Interface)...
* Vérification des composants Kubernetes...
  * Utilisation de l'image grc.io/k8s-minikube/storage-provisioner:v5
* Modules activés: storage-provisioner, default-storageclass
* Terminé ! kubectl est maintenant configuré pour utiliser "minikube" cluster et espace de noms "default" par défaut.
PS C:\Users\phbou>

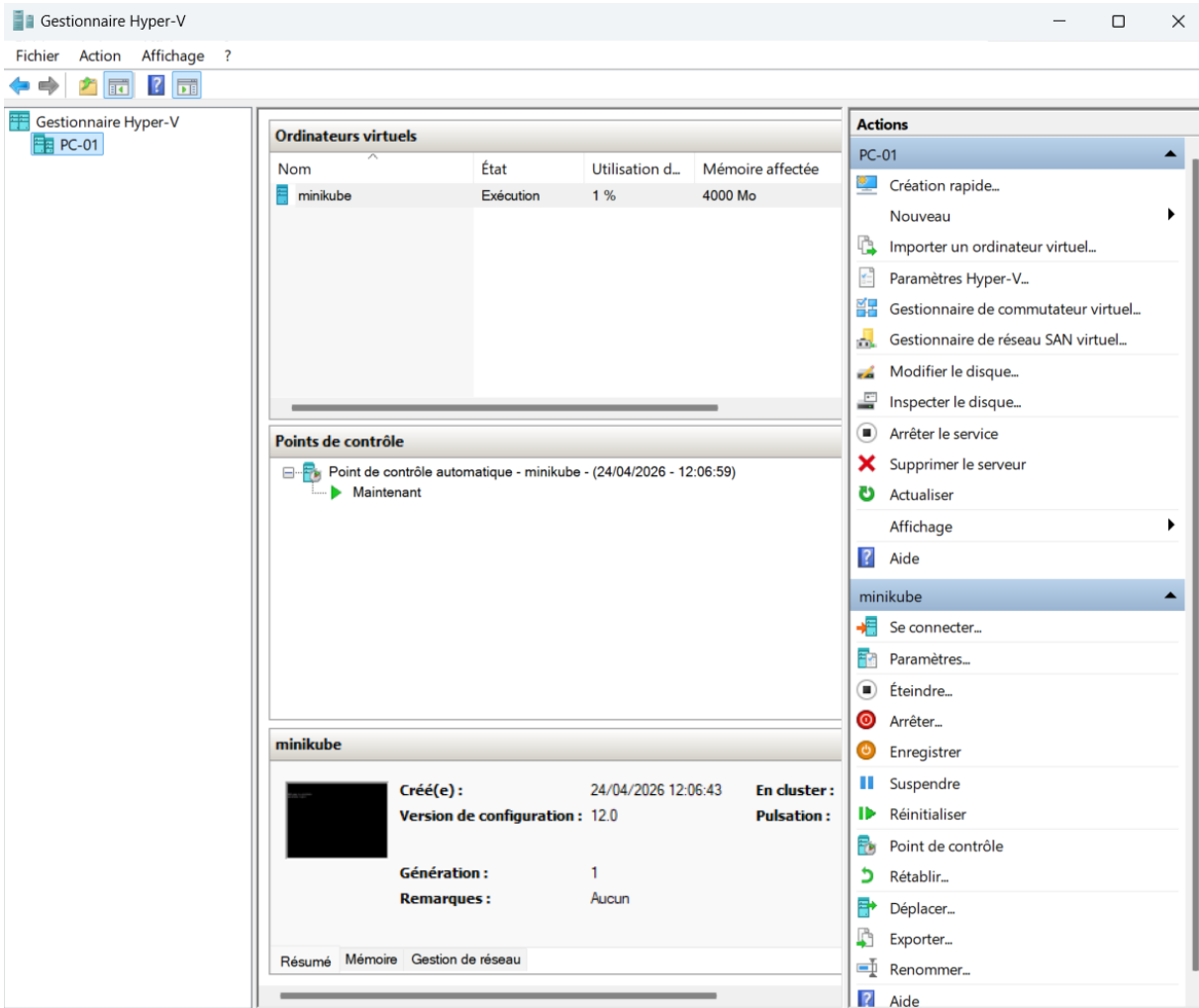
```

`minikube start --driver=hyperv`

```

PS C:\Users\phbou> kubectl get nodes
NAME          STATUS    ROLES    AGE   VERSION
minikube     Ready    control-plane   2m12s   v1.35.1
PS C:\Users\phbou>

```



Commande pour lister les objets :

```
Administrateur : Windows Po... x + v
Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Installez la dernière version de PowerShell pour de nouvelles fonctionnalités et améliorations ! https://aka.ms/PSWindow
s

PS C:\Users\phbou> kubectl get all
NAME                TYPE                CLUSTER-IP    EXTERNAL-IP    PORT(S)    AGE
service/kubernetes  ClusterIP           10.96.0.1     <none>         443/TCP    168m
PS C:\Users\phbou>
```

Mon premier objet (type pod) : créer un pod nginx via kubectl :

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl run monpod --image=nginx:latest
pod/monpod created
PS C:\Users\phbou>
```

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl get pods
NAME    READY   STATUS    RESTARTS   AGE
monpod  1/1     Running   0           2m16s
PS C:\Users\phbou>
```

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl get all
NAME                READY   STATUS    RESTARTS   AGE
pod/monpod          1/1     Running   0           3m41s

NAME                TYPE                CLUSTER-IP    EXTERNAL-IP    PORT(S)    AGE
service/kubernetes  ClusterIP           10.96.0.1     <none>         443/TCP    3h44m
PS C:\Users\phbou>
```

Consulter le log d'un pod :

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl logs pod/monpod
/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: Sourcing /docker-entrypoint.d/15-local-resolvers.envsh
/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
2026/04/24 13:51:17 [notice] #1: using the "epoll" event method
2026/04/24 13:51:17 [notice] #1: nginx/1.29.8
2026/04/24 13:51:17 [notice] #1: built by gcc 14.2.0 (Debian 14.2.0-19)
2026/04/24 13:51:17 [notice] #1: OS: Linux 6.6.95
2026/04/24 13:51:17 [notice] #1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2026/04/24 13:51:17 [notice] #1: start worker processes
2026/04/24 13:51:17 [notice] #1: start worker process 29
2026/04/24 13:51:17 [notice] #1: start worker process 30
PS C:\Users\phbou>
```

Les espaces de noms dans lesquels sont créés les objets :

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl get namespace
NAME                STATUS    AGE
default             Active   5h51m
kube-node-lease     Active   5h51m
kube-public         Active   5h51m
kube-system         Active   5h51m
PS C:\Users\phbou>
```

Les objets : singulier ou pluriel, peu importe

```
Administrateur : Windows Po... x + v
PS C:\Users\phbou> kubectl get pods
NAME    READY   STATUS    RESTARTS   AGE
monpod  1/1     Running   0           134m
PS C:\Users\phbou> kubectl get pod
NAME    READY   STATUS    RESTARTS   AGE
monpod  1/1     Running   0           134m
PS C:\Users\phbou>
```

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get nodes
NAME          STATUS    ROLES    AGE      VERSION
minikube     Ready    control-plane  5h58m   v1.35.1
PS C:\Users\phbou> kubectl get node
NAME          STATUS    ROLES    AGE      VERSION
minikube     Ready    control-plane  5h58m   v1.35.1
PS C:\Users\phbou>

```

Champs supplémentaires :

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get node -o wide
NAME          STATUS    ROLES    AGE      VERSION    INTERNAL-IP    EXTERNAL-IP    OS-IMAGE    KERNEL-VERSION
CONTAINER-RUNTIME
minikube     Ready    control-plane  5h59m   v1.35.1    172.24.254.27  <none>         Buildroot 2025.02    6.6.95
docker://28.5.2
PS C:\Users\phbou>

```

Accéder à Minikube et interroger le démon containerd (commande ctr précédée de sudo afin de récupérer la liste des espaces de noms). Dans le cas où Docker est utilisé comme moteur de conteneur, l'espace de noms porte la valeur moby :

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> minikube ssh

$ sudo ctr namespace ls
NAME LABELS
moby
$ sudo ctr -n moby container ls
CONTAINER          IMAGE          RUNTIME
35fff9295165e3bf917b693c98a6ee1f9341b693d02598ee6d8f680dee485668e - io.containerd.runc.v2
36865546be4d79afbe2808bce66db5c1e28b968a434d5ba0a437a496242a2bf6 - io.containerd.runc.v2
3c4c280d1fa9c2ebc363f7afa38bd17c9a3a477ca54285ecbe85b9603a3b6692 - io.containerd.runc.v2
3f615af2fca7a1832777adebcb9c9029d2046dcb8be87ddd5d72f92bb64cb933 - io.containerd.runc.v2
4a808bf4131ade75ee7d273a55ba60e98939652b2e0902bc4cb3741070155aec - io.containerd.runc.v2
538d69b01454a297c0e83c46598fca11c4326994a816aec17ee5b4914a7da678 - io.containerd.runc.v2
852261b023ea6d91d4bacbda0d9e56a891eadd6ee1f58857eb0a3d3ac7355abc - io.containerd.runc.v2
9040dcbf238a2d37b65e02c35ace93990744976c82c2e66d3fdbb7bfb11a3649 - io.containerd.runc.v2
967fda75e5a46500a32e9ea5399d0bf2805f6db5c96afe10841a21868a638582 - io.containerd.runc.v2
b972e0a9519c293f9751a3969c1292d37db1595ca7274bc4cf69d264e99ee486 - io.containerd.runc.v2
be36e82aac4230eda4c16139a9f8a2033d97f421691d5d46fcd62f10266edb - io.containerd.runc.v2
c7135903cd3aaac6820a90b47ac1942f82554ee35d500eale0c941af1c69aac9 - io.containerd.runc.v2
ca0871baea331c50208a98bb545da778d250f095c12abc047ee9d8fcf77a9b3 - io.containerd.runc.v2
ced17b9a0c7a6ec7a47e7d862abae428e1b249bd46658ddefff45eeec58ca27613 - io.containerd.runc.v2
d0966c13ce321e1d33839ba3bc45bcba4274b19fd22443d6eb4708eb3f8f1acb - io.containerd.runc.v2
d79b63f6f7d35b3fb13d603053c0fbef00b8578192b48a609976a3409aee6b1a - io.containerd.runc.v2
$ exit
logout
PS C:\Users\phbou>

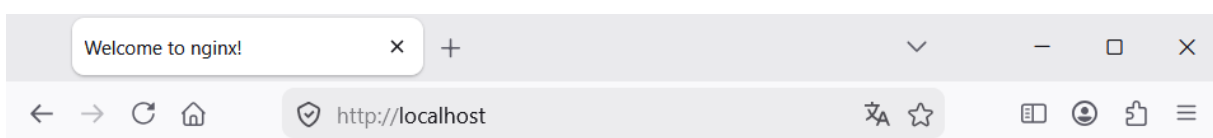
```

Description d'un objet (en l'occurrence un pod) :

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl describe pod/monpod
Name:          monpod
Namespace:    default
Priority:      0
Service Account: default
Node:         minikube/172.24.254.27
Start Time:   Fri, 24 Apr 2026 15:50:25 +0200
Labels:       run=monpod
Annotations:  <none>
Status:       Running
IP:           10.244.0.3
IPs:
  IP: 10.244.0.3
Containers:
  monpod:
    Container ID:  docker://be36e82acac4230eda4c16139a9f8a2033d97f421691d5d46fcd62f10266edeb
    Image:         nginx:latest
    Image ID:      docker-pullable://nginx@sha256:6e23479198b998e5e25921dff8455837c7636a67111a04a635cf1bb363d199dc
    Port:          <none>
    Host Port:     <none>
    State:         Running
      Started:     Fri, 24 Apr 2026 15:51:16 +0200
    Ready:         True
    Restart Count: 0
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-z5txl (ro)
Conditions:
  Type                               Status
  PodReadyToStartContainers          True
  Initialized                         True
  Ready                              True
  ContainersReady                   True
  PodScheduled                       True
Volumes:
  kube-api-access-z5txl:
    Type:          Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds: 3607
    ConfigMapName:  kube-root-ca.crt
    Optional:      false
    DownwardAPI:   true
```

Accéder à l'application Nginx depuis l'extérieur du cluster Kubernetes (instruction port-forward) :

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl port-forward monpod 80
Forwarding from 127.0.0.1:80 -> 80
Forwarding from [::1]:80 -> 80
Handling connection for 80
```



Welcome to nginx!

If you see this page, nginx is successfully installed and working. Further configuration is required for the web server, reverse proxy, API gateway, load balancer, content cache, or other features.

For online documentation and support please refer to nginx.org.
To engage with the community please visit community.nginx.org.
For enterprise grade support, professional services, additional security features and capabilities please refer to f5.com/nginx.

Thank you for using nginx.

Détruire le pod nginx :

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl delete pod/monpod
pod "monpod" deleted from default namespace
PS C:\Users\phbou> kubectl get pod
No resources found in default namespace.
PS C:\Users\phbou>
```

3. Le tableau de bord de Kubernetes.

Activer le plugin :

```
Administrateur : Windows Po...
Windows PowerShell
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Installez la dernière version de PowerShell pour de nouvelles fonctionnalités et améliorations ! https://aka.ms/PSWindow
s

PS C:\Users\phbou> minikube addons enable dashboard
⚠ dashboard est un addon maintenu par Kubernetes. Pour toute question, contactez minikube sur GitHub.
Vous pouvez consulter la liste des mainteneurs de minikube sur : https://github.com/kubernetes/minikube/blob/master/OWNE
RS
  ▪ Utilisation de l'image docker.io/kubernetesui/metrics-scra...
  ▪ Utilisation de l'image docker.io/kubernetesui/dashboard:v2.7.0
⚠ Certaines fonctionnalités du tableau de bord nécessitent le module complémentaire metrics-server. Pour activer toute
s les fonctionnalités, veuillez exécuter :

    minikube addons enable metrics-server

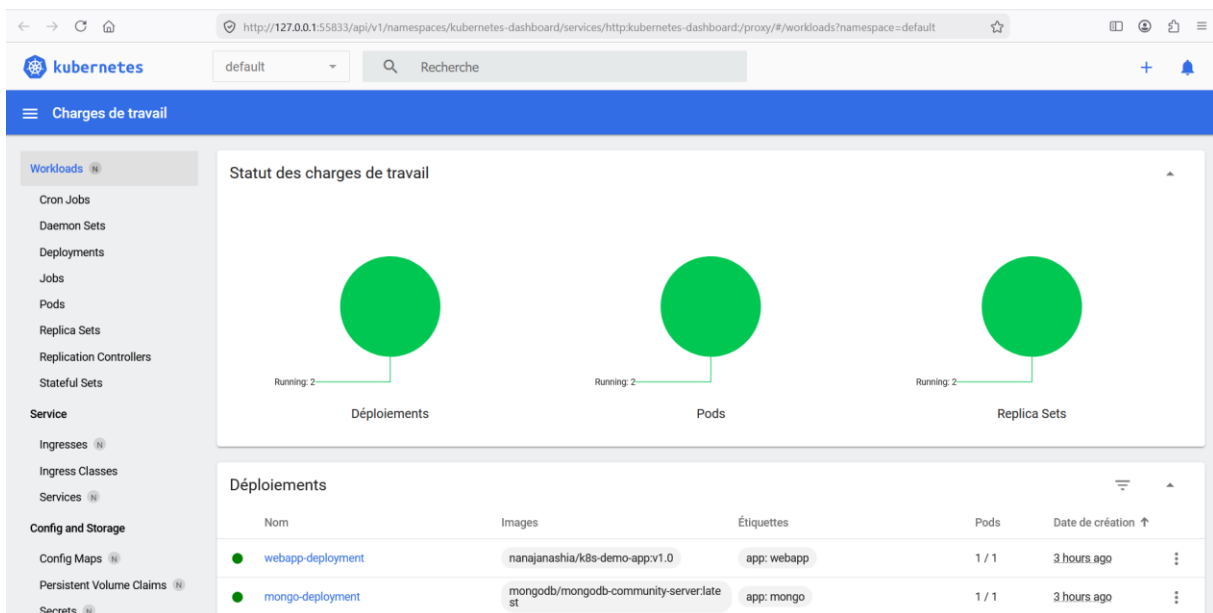
🌟 Le module 'dashboard' est activé
PS C:\Users\phbou>
```

Comme indiqué ci-dessus, activer le serveur de métriques pour bénéficier de l'ensemble des fonctionnalités du tableau de bord :

```
Administrateur : Windows Po...
PS C:\Users\phbou> minikube addons enable metrics-server
⚠ metrics-server est un addon maintenu par Kubernetes. Pour toute question, contactez minikube sur GitHub.
Vous pouvez consulter la liste des mainteneurs de minikube sur : https://github.com/kubernetes/minikube/blob/master/OWNE
RS
  ▪ Utilisation de l'image registry.k8s.io/metrics-server/metrics-server:v0.8.1
🌟 Le module 'metrics-server' est activé
PS C:\Users\phbou>
```

Accès au tableau de bord :

```
Administrateur : Windows Po...
PS C:\Users\phbou> minikube dashboard
👉 Vérification de l'état du tableau de bord...
👉 Lancement du proxy...
👉 Vérification de l'état du proxy...
👉 Ouverture de http://127.0.0.1:55833/api/v1/namespaces/kubernetes-dashboard/services/http:kubernetes-dashboard:/proxy
/ dans votre navigateur par défaut...
```



Storage Classes

Cluster

- Cluster Role Bindings
- Cluster Roles
- Events
- Namespaces
- Network Policies
- Nodes
- Persistent Volumes
- Role Bindings
- Roles
- Service Accounts
- Custom Resource Definitions
- Settings

Pods

Nom	Images	Étiquettes	Noeud	Statut	Redémarr	Utilisation CPU (coeurs)	Utilisation mémoire (octets)	Date de création
webapp-deployment-5766fd95c7-cb4wg	nanajanashia/k8s-demo-app:v1.0	app: webapp pod-template-hash: 5766fd95c7	minikube	Running	0	0,00m	24,85Mi	3 hours ago
mongo-deployment-744864fdd7-bnpgx	mongodb/mongodb-community-server:latest	app: mongo pod-template-hash: 744864fdd7	minikube	Running	0	18,00m	210,55Mi	3 hours ago

Replica Sets

Nom	Images	Étiquettes	Pods	Date de création
webapp-deployment-5766fd95c7	nanajanashia/k8s-demo-app:v1.0	app: webapp pod-template-hash: 5766fd95c7	1 / 1	3 hours ago
mongo-deployment-744864fdd7	mongodb/mongodb-community-server:latest	app: mongo pod-template-hash: 744864fdd7	1 / 1	3 hours ago

Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets
- Service
- Ingresses
- Ingress Classes
- Services

Services

Nom	Étiquettes	Type	IP cluster	Terminaisons Internes	Terminaisons externes	Date de création
webapp-service	-	NodePort	10.104.147.146	webapp-service:3000 TCP webapp-service:30100 TCP	-	4 hours ago
mongo-service	-	ClusterIP	10.108.31.5	mongo-service:27017 TCP mongo-service:0 TCP	-	4 hours ago
kubernetes	component: apiserver provider: kubernetes	ClusterIP	10.96.0.1	kubernetes:443 TCP kubernetes:0 TCP	-	2 days ago

Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets
- Service
- Ingresses
- Ingress Classes
- Services
- Config and Storage
- Config Maps

Config Maps

Nom	Étiquettes	Date de création
mongo-config	-	4 hours ago
kube-root-ca.crt	-	2 days ago

Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets
- Service
- Ingresses
- Ingress Classes
- Services
- Config and Storage
- Config Maps
- Persistent Volume Claims
- Secrets

Secrets

Nom	Étiquettes	Type	Date de création
mongo-secret	-	Opaque	4 hours ago

Espaces de noms				
Nom	Étiquettes	Phase	Date de création ↑	
● kubernetes-dashboard	addonmanager.kubernetes.io/mode: Reconcile kubernetes.io/metadata.name: kubernet es-dashboard kubernetes.io/minikube-addons: dashbo ard	Active	23 minutes ago	
● default	kubernetes.io/metadata.name: default	Active	2 days ago	
● kube-node-lease	kubernetes.io/metadata.name: kube-nod e-lease	Active	2 days ago	
● kube-public	kubernetes.io/metadata.name: kube-publ ic	Active	2 days ago	
● kube-system	kubernetes.io/metadata.name: kube-syst em	Active	2 days ago	

CPU Usage

Memory Usage

Noeuds										
Nom	Étiquettes	Prêt	Requêtes CPU (coeurs)	Limites CPU (coeurs)	CPU capacity (coeurs)	Requêtes mémoire (octets)	Limites mémoire (octets)	Memory capacity (bytes)	Pods	Date d création
● minikube	beta.kubernetes.io/arch: amd64 beta.kubernetes.io/os: linux kubernetes.io/arch: amd64	True	850,00m (42,50%)	0,00m (0,00%)	2,00	370,00Mi (9,71%)	170,00Mi (4,46%)	3,72Gi	12 (10,91%)	2 days ago

Création d'un déploiement (mailpit) :

kubernetes

default

Recherche

+ Créer une nouvelle ressource

Charges de travail > Déploiements

Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets

Service

- Ingresses
- Ingress Classes
- Services

CPU Usage

Memory Usage

Déploiements				
Nom	Images	Étiquettes	Pods	Date de création ↑
● webapp-deployment	nanajanashia/k8s-demo-app:v1.0	app: webapp	1 / 1	4 hours ago
● mongo-deployment	mongodb/mongodb-community-server-late st	app: mongo	1 / 1	4 hours ago

Créer en ligne Créer depuis un fichier **Créer depuis un formulaire**

Nom de l'application *
mailpit 7 / 24

Image du conteneur *
axlent/mailpit

Nombre de pods *
1

Service *
None

Espace de nom *
default

Une étiquette 'app' avec cette valeur sera ajoutée au déploiement et au service qui seront déployés. [En savoir plus](#)

Saisissez l'URL d'une image publique d'un quelconque registre ou une image privée hébergée dans Docker Hub ou Google Container Registry. [En savoir plus](#)

Un déploiement sera créé pour maintenir le nombre désiré de pods dans votre cluster. [En savoir plus](#)

Éventuellement, un Service interne ou externe peut être défini pour mapper un port entrant à un port cible vu par le conteneur. [En savoir plus](#)

Les espaces de noms vous permettent de distribuer vos ressources dans des groupes logiques nommés. [En savoir plus](#)

Déployer Preview Annuler Afficher les options avancées

Déploiements


Nom	Images	Étiquettes	Pods	Date de création ↑
mailpit	axlent/mailpit	k8s-app: mailpit	1 / 1	25 seconds ago
webapp-deployment	nanajanashia/k8s-demo-app:v1.0	app: webapp	1 / 1	4 hours ago
mongo-deployment	mongodb/mongodb-community-server:latest	app: mongo	1 / 1	4 hours ago

Pods

Nom	Images	Étiquettes	Noeud	Statut	Redéman	Utilisation CPU (coeurs)	Utilisation mémoire (octets)	Date de création ↑
mailpit-5d8c9cd4-z7hkb	axlent/mailpit	k8s-app: mailpit pod-template-hash: 5d8c9cd4	minikube	Running	0	-	-	24 seconds ago


Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets
- Service**
- Ingresses
- Ingress Classes
- Services
- Config and Storage**
- Config Maps
- Persistent Volume Claims
- Secrets




Running: 3

Déploiements



Running: 3

Pods



Running: 3

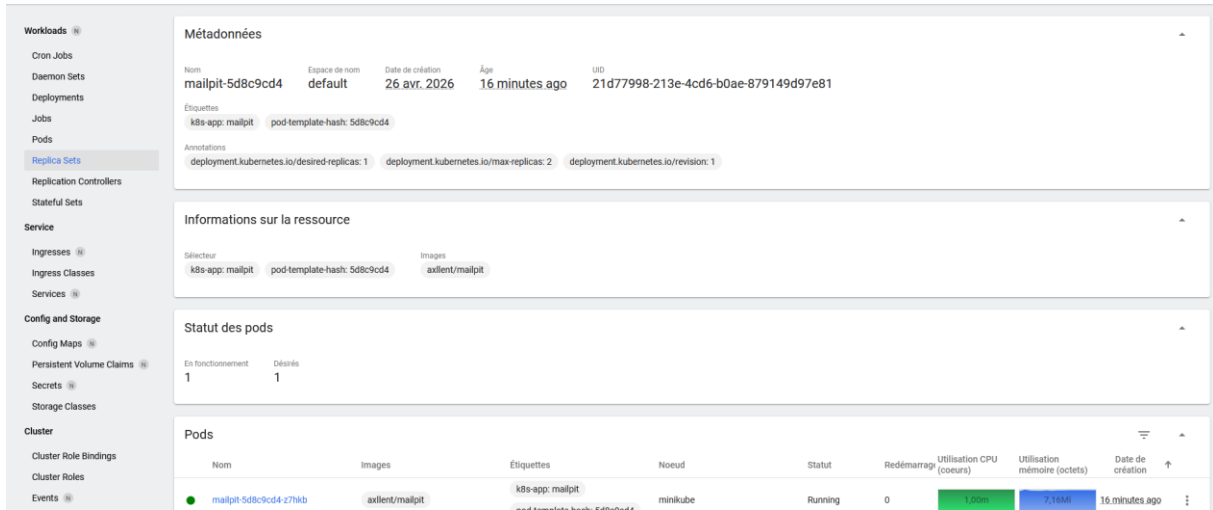
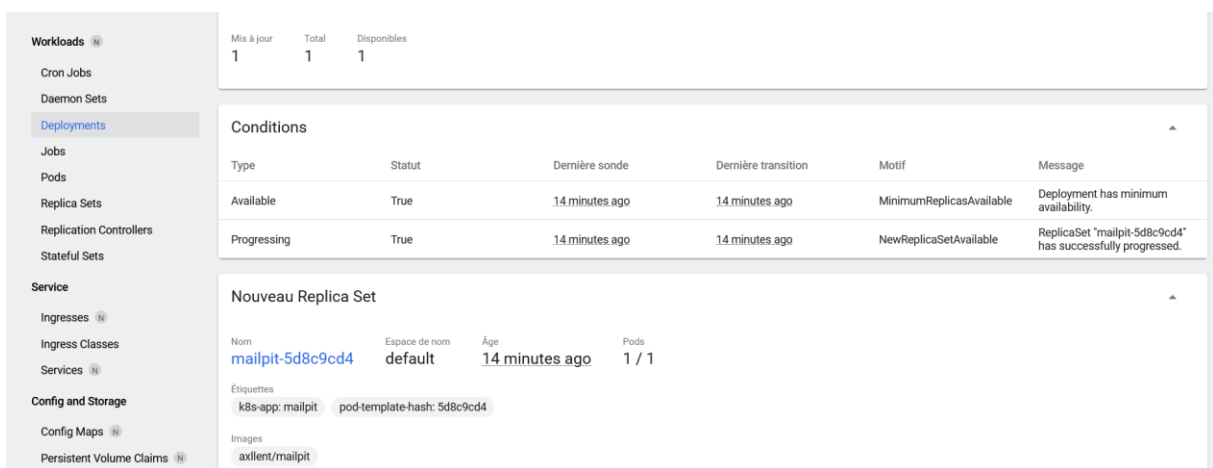
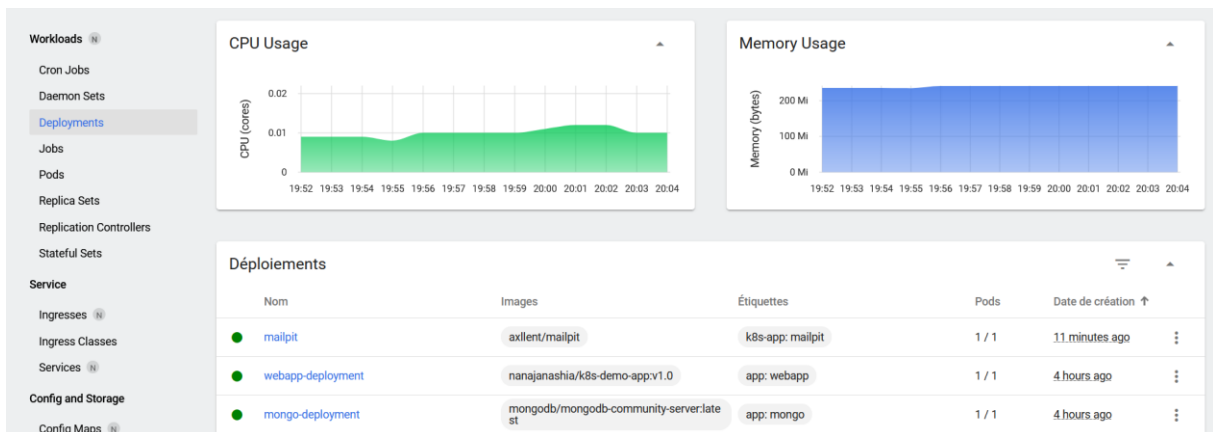
Replica Sets

Déploiements

Nom	Images	Étiquettes	Pods	Date de création ↑
mailpit	axlent/mailpit	k8s-app: mailpit	1 / 1	2 minutes ago
webapp-deployment	nanajanashia/k8s-demo-app:v1.0	app: webapp	1 / 1	4 hours ago
mongo-deployment	mongodb/mongodb-community-server:latest	app: mongo	1 / 1	4 hours ago

Pods

Nom	Images	Étiquettes	Noeud	Statut	Redéman	Utilisation CPU (coeurs)	Utilisation mémoire (octets)	Date de création ↑
mailpit-5d8c9cd4-z7hkb	axlent/mailpit	k8s-app: mailpit pod-template-hash: 5d8c9cd4	minikube	Running	0	1,00m	6,86Mi	2 minutes ago



Voir les journaux :

Charges de travail > Pods > mailpit-5d8c9cd4-z7hkb

CPU Usage

Memory Usage

Métadonnées

Nom	Espace de nom	Date de création	Âge	UID
mailpit-5d8c9cd4-z7hkb	default	26 avr. 2026	18 minutes ago	b2502bd7-3b21-446d-99a6-b02a8d817624

Étiquettes: k8s-app: mailpit, pod-template-hash: 5d8c9cd4

Informations sur la ressource

Nœud	Statut	IP	QoS Class	Replanements	Service Account
minikube	Running	10.244.0.12	BestEffort	0	default

Conditions

Charges de travail > Pods > mailpit-5d8c9cd4-z7hkb > Journaux

Journaux de mailpit dans mailpit-5d8c9c...

```

time="2026/04/26 17:55:03" level=info msg="[smtpd] starting on [::]:1025 (no encryption)"
time="2026/04/26 17:55:03" level=info msg="[cors] allowed API origins: "
time="2026/04/26 17:55:03" level=info msg="[http] starting on [::]:8025"
time="2026/04/26 17:55:03" level=info msg="[http] accessible via http://localhost:8025/"
  
```

Logs from 26 avr. 2026 to 26 avr. 2026 UTC

Scalabilité :

Charges de travail > Déploiements > mailpit

Métadonnées

Nom	Espace de nom	Date de création	Âge	UID
mailpit	default	26 avr. 2026	23 minutes ago	b268d016-7412-4566-b9f9-ed299056acb

Étiquettes: k8s-app: mailpit

Annotations: deployment.kubernetes.io/revision: 1

Mettre à l'échelle une ressource

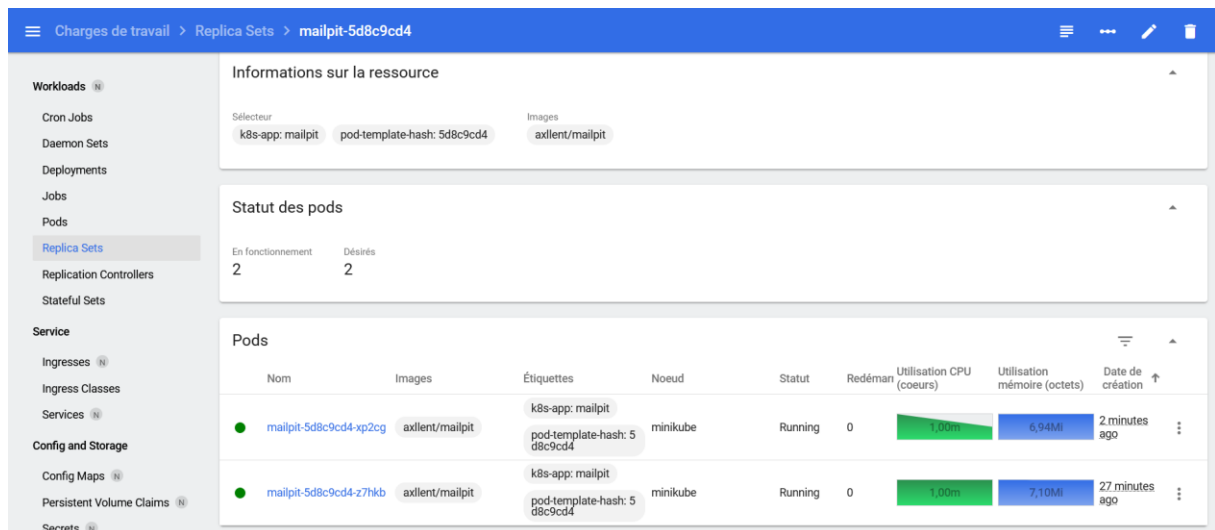
Deployment mailpit will be updated to reflect the desired replicas count.

Répliques désirées * Répliques actuelles

2 | 1

 Cette action est équivalente à : `kubectl scale -n default deployment mailpit --replicas=2`

[Mettre à l'échelle](#) [Annuler](#)



Charges de travail > Replica Sets > mailpit-5d8c9cd4

Informations sur la ressource

Sélecteur: k8s-app: mailpit | Images: axllent/mailpit

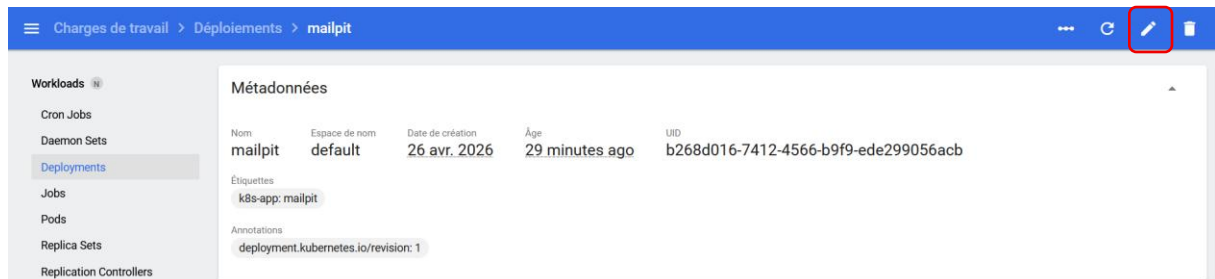
Statut des pods

En fonctionnement	Désirés
2	2

Pods

Nom	Images	Étiquettes	Noeud	Statut	Redémar	Utilisation CPU (coeurs)	Utilisation mémoire (octets)	Date de création
mailpit-5d8c9cd4-xp2cg	axllent/mailpit	k8s-app: mailpit pod-template-hash: 5d8c9cd4	minikube	Running	0	1,00m	6,94Mi	2 minutes ago
mailpit-5d8c9cd4-z7hkb	axllent/mailpit	k8s-app: mailpit pod-template-hash: 5d8c9cd4	minikube	Running	0	1,00m	7,10Mi	27 minutes ago

Mise à jour :



Charges de travail > Déploiements > mailpit

Métadonnées

Nom	Espace de nom	Date de création	Âge	UID
mailpit	default	26 avr. 2026	29 minutes ago	b268d016-7412-4566-b9f9-ede299056acb

Étiquettes: k8s-app: mailpit

Annotations: deployment.kubernetes.io/revision: 1

Éditer une ressource


YAML	JSON
1	kind: Deployment
2	apiVersion: apps/v1
3	metadata:
4	name: mailpit
5	namespace: default
6	uid: b268d016-7412-4566-b9f9-ed299056acb
7	resourceVersion: '64618'
8	generation: 2
9	creationTimestamp: '2026-04-26T17:54:48Z'
10	labels:
11	k8s-app: mailpit
12	annotations:
13	deployment.kubernetes.io/revision: '1'
14	managedFields:
15	- manager: dashboard
16	operation: Update
17	apiVersion: apps/v1
18	fieldsType: FieldsV1
19	fieldsV1:
20	f:spec:
21	f:replicas: {}
22	subresource: scale
23	manager: dashboard

 Cette action est équivalente à : `kubectl apply -f <spec.yaml>`

[Mettre à jour](#) [Annuler](#)

Éditer une ressource

YAML	JSON
97	r:observeGeneration: {}
98	f:readyReplicas: {}
99	f:replicas: {}
100	f:terminatingReplicas: {}
101	f:updatedReplicas: {}
102	subresource: status
103	spec:
104	replicas: 2
105	selector:
106	matchLabels:
107	k8s-app: mailpit
108	template:
109	metadata:
110	name: mailpit
111	labels:
112	k8s-app: mailpit
113	spec:
114	containers:
115	- name: mailpit
116	image: axllent/mailpit:latest
117	resources: {}
118	terminationMessagePath: /dev/termination-log
119	terminationMessagePolicy: File

 Cette action est équivalente à : `kubectl apply -f <spec.yaml>`

[Mettre à jour](#) [Annuler](#)

Kubernetes va créer un nouveau ReplicaSet :

The screenshot shows the Kubernetes dashboard interface. At the top, there's a navigation bar with 'Charges de travail' and 'Replica Sets'. On the left, a sidebar lists various workload types like Cron Jobs, Daemon Sets, Deployments, Jobs, Pods, and Replica Sets. The main area is divided into several sections:

- CPU Usage:** A line graph showing CPU usage in cores over time, fluctuating between 0 and 0.02.
- Memory Usage:** A line graph showing memory usage in bytes over time, fluctuating between 0 and 200 Mi.
- Replica Sets:** A table listing active Replica Sets with columns for Name, Images, Labels, Pods, and Date of creation.

Nom	Images	Étiquettes	Pods	Date de création
mailpit-6f94d7dc8f	axilent/mailpit:latest	k8s-app: mailpit pod-template-hash: 6f94d7dc8f	2 / 2	4 minutes ago
mailpit-5d8c9cd4	axilent/mailpit	k8s-app: mailpit pod-template-hash: 5d8c9cd4	0 / 0	37 minutes ago
webapp-deployment-5766fd95c7	nanajanashia/k8s-demo-app:v1.0	app: webapp pod-template-hash: 5766fd95c7	1 / 1	5 hours ago
- Nouveau Replica Set:** A section showing the details of a newly created Replica Set named 'mailpit-6f94d7dc8f' in the 'default' namespace, with 2 pods and labels 'k8s-app: mailpit' and 'pod-template-hash: 6f94d7dc8f'. The image used is 'axilent/mailpit:latest'.
- Anciens Replica Sets:** A section indicating that no old Replica Sets are currently displayed.

En résumé, la création d'un déploiement d'application se traduit par :

- La création d'un ReplicaSet ;
- La création d'un Pod associé au ReplicaSet ;
- Le démarrage d'un conteneur.

Une mise à jour du déploiement se traduira par la création d'un nouveau ReplicaSet

4. Créer un déploiement à l'aide de l'outil kubectl.

Le § précédent a permis le déploiement d'une application via le dashboard. Cette fois-ci, les opérations seront réalisées en ligne de commande via la commande kubectl.

Suppression d'un déploiement :

```

Administrateur : Windows Po...
Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Installez la dernière version de PowerShell pour de nouvelles fonctionnalités et améliorations ! https://aka.ms/PSWindows

PS C:\Users\phbou> kubectl get deployment
NAME          READY  UP-TO-DATE  AVAILABLE  AGE
mailpit       2/2    2           2          42h
mongo-deployment  1/1    1           1          47h
webapp-deployment  1/1    1           1          47h
PS C:\Users\phbou>

Administrateur : Windows Po...
PS C:\Users\phbou> kubectl delete deployment mailpit
deployment.apps "mailpit" deleted from default namespace
PS C:\Users\phbou>
  
```

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get deployment
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
mongo-deployment  1/1     1             1           47h
webapp-deployment 1/1     1             1           47h
PS C:\Users\phbou>

```

Création d'un déploiement

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl create deployment mailpit --image=axllent/mailpit
deployment.apps/mailpit created
PS C:\Users\phbou>

```

Etat du déploiement

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get deployment
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
mailpit       0/1     1             0           118s
mongo-deployment  1/1     1             1           47h
webapp-deployment 1/1     1             1           47h
PS C:\Users\phbou> kubectl get deployment -o wide
NAME          READY   UP-TO-DATE   AVAILABLE   AGE   CONTAINERS   IMAGES                                     SELECTOR
mailpit       0/1     1             0           2m31s mailpit      axllent/mailpit                          app=mailpit
mongo-deployment  1/1     1             1           47h   mongoddb    mongodb/mongodb-community-server:latest  app=mongo
webapp-deployment 1/1     1             1           47h   webapp      nanajanashia/k8s-demo-app:v1.0          app=webapp
PS C:\Users\phbou>

```

```

Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl describe deployment mailpit
Name:          mailpit
Namespace:    default
CreationTimestamp: Tue, 28 Apr 2026 15:05:08 +0200
Labels:       app=mailpit
Annotations:  deployment.kubernetes.io/revision: 1
Selector:     app=mailpit
Replicas:     1 desired | 1 updated | 1 total | 0 available | 1 unavailable
StrategyType: RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=mailpit
  Containers:
    mailpit:
      Image:          axllent/mailpit
      Port:           <none>
      Host Port:      <none>
      Environment:    <none>
      Mounts:         <none>
  Volumes:          <none>
  Node-Selectors:   <none>
  Tolerations:      <none>
Conditions:
  Type           Status  Reason
  ----           -
  Available      False   MinimumReplicasUnavailable
  Progressing    True    ReplicaSetUpdated
OldReplicaSets: <none>
NewReplicaSet:  mailpit-7b96b48c5d (1/1 replicas created)
Events:
  Type           Reason          Age    From          Message
  ----           -
  Normal         ScalingReplicaSet   3m45s deployment-controller  Scaled up replica set mailpit-7b96b48c5d from 0 to 1
PS C:\Users\phbou>

```

Réplicas :

```

Administrateur : Windows Po...
PS C:\Users\phbou> kubectl get replicaset
NAME                                DESIRED    CURRENT    READY    AGE
mailpit-7b96b48c5d                 1          1          0        7m24s
mongo-deployment-744864fdd7        1          1          1        47h
webapp-deployment-5766fd95c7       1          1          1        47h
PS C:\Users\phbou> kubectl describe rs mailpit-7b96b48c5d
Name:                                mailpit-7b96b48c5d
Namespace:                           default
Selector:                             app=mailpit,pod-template-hash=7b96b48c5d
Labels:                               app=mailpit
                                         pod-template-hash=7b96b48c5d
Annotations:                           deployment.kubernetes.io/desired-replicas: 1
                                         deployment.kubernetes.io/max-replicas: 2
                                         deployment.kubernetes.io/revision: 1
Controlled By:                         Deployment/mailpit
Replicas:                              1 current / 1 desired
Pods Status:                           0 Running / 1 Waiting / 0 Succeeded / 0 Failed
Pod Template:
  Labels:                               app=mailpit
                                         pod-template-hash=7b96b48c5d
  Containers:
    mailpit:
      Image:                             axllent/mailpit
      Port:                               <none>
      Host Port:                         <none>
      Environment:                       <none>
      Mounts:                             <none>
      Volumes:                             <none>
      Node-Selectors:                     <none>
      Tolerations:                       <none>
Events:
  Type     Reason          Age   From          Message
  ----     -
Normal    SuccessfulCreate 8m23s replicaset-controller Created pod: mailpit-7b96b48c5d-j4gbf
PS C:\Users\phbou>

```

Etat du pod

```

Administrateur : Windows Po...
PS C:\Users\phbou> kubectl get pods
NAME                                READY    STATUS    RESTARTS    AGE
mailpit-7b96b48c5d-4b8p2           1/1     Running   0            2m8s
mongo-deployment-744864fdd7-bnpgx  1/1     Running   0            2d
webapp-deployment-5766fd95c7-cb4wg  1/1     Running   0            2d
PS C:\Users\phbou> kubectl describe pods mailpit-7b96b48c5d-4b8p2
Name:                                mailpit-7b96b48c5d-4b8p2
Namespace:                           default
Priority:                              0
Service Account:                      default
Node:                                  minikube/172.24.254.27
Start Time:                            Tue, 28 Apr 2026 15:31:51 +0200
Labels:                                app=mailpit
                                         pod-template-hash=7b96b48c5d
Annotations:                           <none>
Status:                                 Running
IP:                                     10.244.0.18
IPs:
  IP:                                   10.244.0.18
Controlled By:                         ReplicaSet/mailpit-7b96b48c5d
Containers:
  mailpit:
    Container ID:                       docker://3288092024fea2f4d55891dc474486e879e84ed0cd7eb584882d9bd9120c81b9
    Image:                               axllent/mailpit
    Image ID:                             docker-pullable://axllent/mailpit@sha256:757f22b56c1da03570afdb3d259effe5091018008a81bbec8158cee7e16fdbc
    Port:                               <none>
    Host Port:                           <none>
    State:                               Running
      Started:                            Tue, 28 Apr 2026 15:31:53 +0200
    Ready:                               True
    Restart Count:                        0
    Environment:                         <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-6zxkq (ro)
Conditions:
  Type             Status
  PodReadyToStartContainers  True
  Initialized        True
  Ready              True
  ContainersReady    True

```

Accès aux logs du pod et des conteneurs

```

Administrateur : Windows Po...
PS C:\Users\phbou> kubectl logs mailpit-7b96b48c5d-4b8p2
time="2026/04/28 13:31:53" level=info msg="[smtpd] starting on [::]:1025 (no encryption)"
time="2026/04/28 13:31:53" level=info msg="[cors] allowed API origins: "
time="2026/04/28 13:31:53" level=info msg="[http] starting on [::]:8025"
time="2026/04/28 13:31:53" level=info msg="[http] accessible via http://localhost:8025/"
PS C:\Users\phbou> kubectl logs mailpit-7b96b48c5d-4b8p2 -c mailpit
time="2026/04/28 13:31:53" level=info msg="[smtpd] starting on [::]:1025 (no encryption)"
time="2026/04/28 13:31:53" level=info msg="[cors] allowed API origins: "
time="2026/04/28 13:31:53" level=info msg="[http] starting on [::]:8025"
time="2026/04/28 13:31:53" level=info msg="[http] accessible via http://localhost:8025/"
PS C:\Users\phbou>

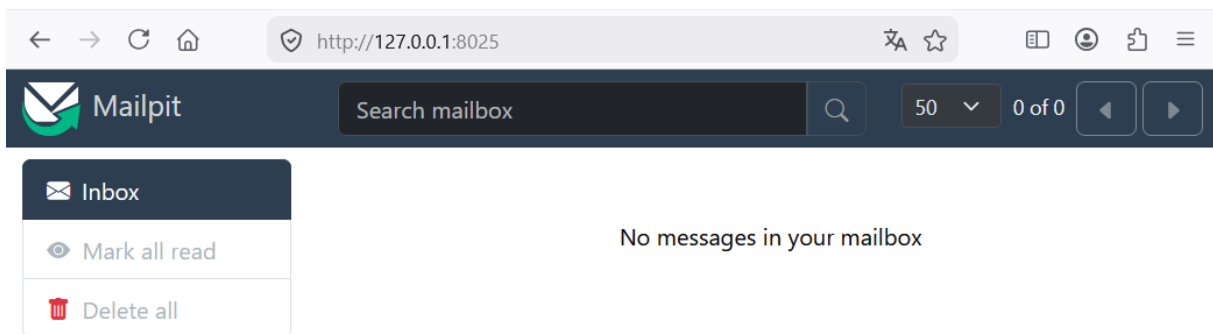
```

Accès à l'application Mailpit

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl port-forward mailpit-7b96b48c5d-4b8p2 8025
Forwarding from 127.0.0.1:8025 -> 8025
Forwarding from [::1]:8025 -> 8025
```

Ou

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl port-forward deployment/mailpit 8025
Forwarding from 127.0.0.1:8025 -> 8025
Forwarding from [::1]:8025 -> 8025
Handling connection for 8025
Handling connection for 8025
```



Exposition d'un déploiement via un **service** (adresse de service) : **l'instruction expose**

Précédemment, l'accès à l'application Mailpit s'est faite via le nom du pod. Or, le pod peut venir à disparaître et le nom changera lors de la création d'un nouveau pod.

Afin de simplifier l'accès à un service hébergé dans un pod, il sera donc nécessaire de passer par un nom de service.

- ➔ **Création d'une entrée DNS stable dans Kubernetes** (l'entrée doit pointer sur le pod faisant tourner l'application Mailpit) et MAJ de l'entrée DNS du service en cas de changement de pod sans compter la répartition de charge dans le cas où le déploiement procéderait à la création de plusieurs pods.

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl expose deployment/mailpit --port 1025,8025
service/mailpit exposed
PS C:\Users\phbou>
```

Il n'est pas possible d'interroger le serveur DNS de Kubernetes depuis l'extérieur du cluster. Il faut pour cela lancer une requête DNS depuis le pod de Mailpit en mode **interactif**.

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl exec -it mailpit-7b96b48c5d-4b8p2 -- sh
/# getent hosts mailpit
10.104.143.161 mailpit.default.svc.cluster.local mailpit.default.svc.cluster.local mailpit
/#
```

Lancement d'un pod de test :

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl run -it --rm pod-test --image=alpine sh
All commands and output from this session will be recorded in container logs, including credentials and sensitive information passed through the command prompt.
If you don't see a command prompt, try pressing enter.
/ # nslookup mailpit
Server:      10.96.0.10
Address:    10.96.0.10:53

** server can't find mailpit.cluster.local: NXDOMAIN

** server can't find mailpit.cluster.local: NXDOMAIN

** server can't find mailpit.svc.cluster.local: NXDOMAIN

** server can't find mailpit.svc.cluster.local: NXDOMAIN

Name:      mailpit.default.svc.cluster.local
Address: 10.104.143.161

/ # exit
Session ended, resume using 'kubectl attach pod-test -c pod-test -i -t' command when the pod is running
pod "pod-test" deleted from default namespace
PS C:\Users\phbou>
```

Résilience et scalabilité (augmenter le niveau de résilience d'une application et augmenter la capacité de trafic d'une application pour répondre à des contraintes de charge)

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl scale deployment mailpit --replicas=2
deployment.apps/mailpit scaled
PS C:\Users\phbou>
```

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get deployment mailpit
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mailpit   2/2     2            2           113m
PS C:\Users\phbou> kubectl get pods -l app=mailpit
NAME                                READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-4b8p2            1/1    Running   0          114m
mailpit-7b96b48c5d-6zq2d            1/1    Running   0          106s
PS C:\Users\phbou>
```

Ingress et reverse proxy

L'application mailpit n'est pas accessible depuis l'extérieur sauf à utiliser la commande kubectl port-forward. L'objet Ingress a été conçu pour permettre cet accès.

Un proxy inverse est un composant qui se situe en amont d'un autre permettant :

- D'accéder à une application inaccessible directement depuis l'extérieur ;
- De répartir la charge sur plusieurs machines.

Exemple : Haproxy, Nginx.

Minikube dispose d'un contrôleur Ingress s'appuyant sur Nginx qu'il suffit d'activer.

Activation du contrôleur Ingress dans Minikube :

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> minikube addons enable ingress
🔔 ingress est un addon maintenu par Kubernetes. Pour toute question, contactez minikube sur GitHub.
Vous pouvez consulter la liste des mainteneurs de minikube sur : https://github.com/kubernetes/minikube/blob/master/OWNERS
  ▪ Utilisation de l'image registry.k8s.io/ingress-nginx/controller:v1.14.3
  ▪ Utilisation de l'image registry.k8s.io/ingress-nginx/kube-webhook-certgen:v1.6.7
  ▪ Utilisation de l'image registry.k8s.io/ingress-nginx/kube-webhook-certgen:v1.6.7
🔔 Vérification du module ingress...
🌟 Le module 'ingress' est activé
PS C:\Users\phbou>
```

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get namespace
NAME          STATUS   AGE
default       Active  4d6h
ingress-nginx Active  4m22s
kube-node-lease Active  4d6h
kube-public   Active  4d6h
kube-system   Active  4d6h
kubernetes-dashboard Active  47h
PS C:\Users\phbou> |
```

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl -n ingress-nginx get pods -l app.kubernetes.io/name
NAME                                READY   STATUS    RESTARTS   AGE
ingress-nginx-admission-create-c6z74 0/1     Completed 0           5m52s
ingress-nginx-admission-patch-qbbmw   0/1     Completed 0           5m52s
ingress-nginx-controller-596f8778bc-gff7g 1/1     Running   0           5m52s
PS C:\Users\phbou> |
```

Déclaration d'une règle Ingress et prise en compte du fichier YAML :

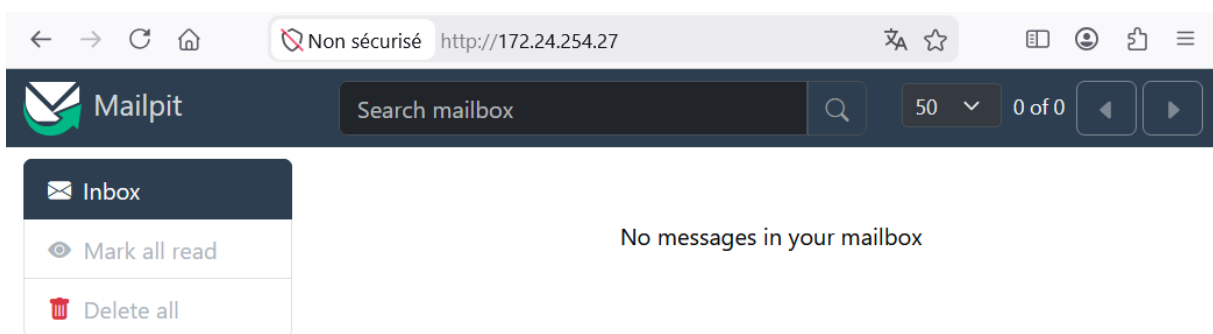
```
File Edit Selection View Go Run Terminal Help < -> Q Untitled (Workspace) [Administrator]
EXPLORER
  OPEN EDITORS
    ! ingress.yaml Mailpit
    ! ingress1.yaml Mailpit
  UNTITLED ...
  Kubernetes
    ! mongo-config.yaml
    ! mongo-secret.yaml
    ! mongo.yaml
    ! webapp.yaml
  Mailpit
    ! ingress.yaml
    ! ingress1.yaml

! ingress.yaml x ! ingress1.yaml
Mailpit > ! ingress.yaml > {} spec > {} rules > {} 0 > {} http > {} paths > {} 0 > {} backend > {} service > {} port > # number
1  apiVersion: networking.k8s.io/v1
2  kind: Ingress
3  metadata:
4    name: test-ingress
5  spec:
6    rules:
7    - http:
8      paths:
9      - path: /
10       pathType: Prefix
11       backend:
12         service:
13           name: mailpit
14           port:
15             number: 8025

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
• PS C:\Users\phbou\Documents\B1sem4\Mailpit> kubectl apply -f ingress.yaml
  ingress.networking.k8s.io/test-ingress configured
○ PS C:\Users\phbou\Documents\B1sem4\Mailpit> |
```

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> kubectl get ingress
NAME          CLASS  HOSTS   ADDRESS      PORTS   AGE
test-ingress  nginx  *      172.24.254.27 80      6m20s
PS C:\Users\phbou> |
```

```
Administrateur : Windows Poi x + v
PS C:\Users\phbou> minikube ip
172.24.254.27
PS C:\Users\phbou> |
```



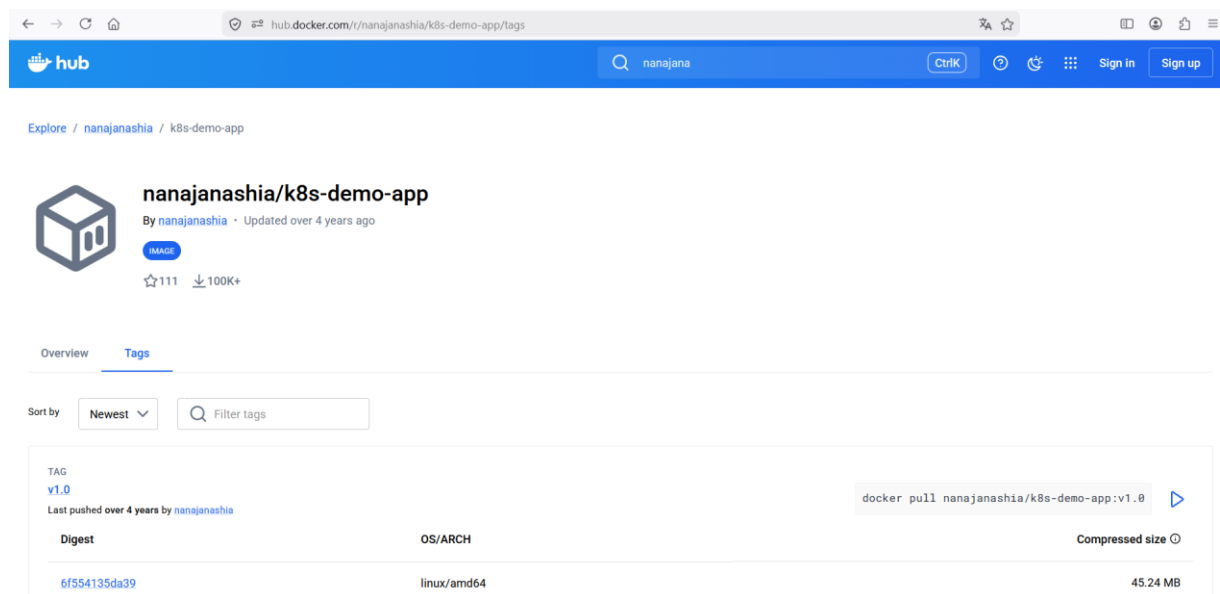
5. Automatisation de déploiement par fichier YAML.

Déploiement Nana :

Précédemment, l'application Mailpit a été déployée avec le **dashboard** de kubernetes puis à l'aide de la commande kubectl avec l'option **create**.

Cette fois-ci la prise en compte de la création des objets sera faite à l'aide de la commande kubectl avec l'option **apply -f** suivi du nom du fichier YAML comme vu avec le fichier établi pour la création de l'objet Ingress.

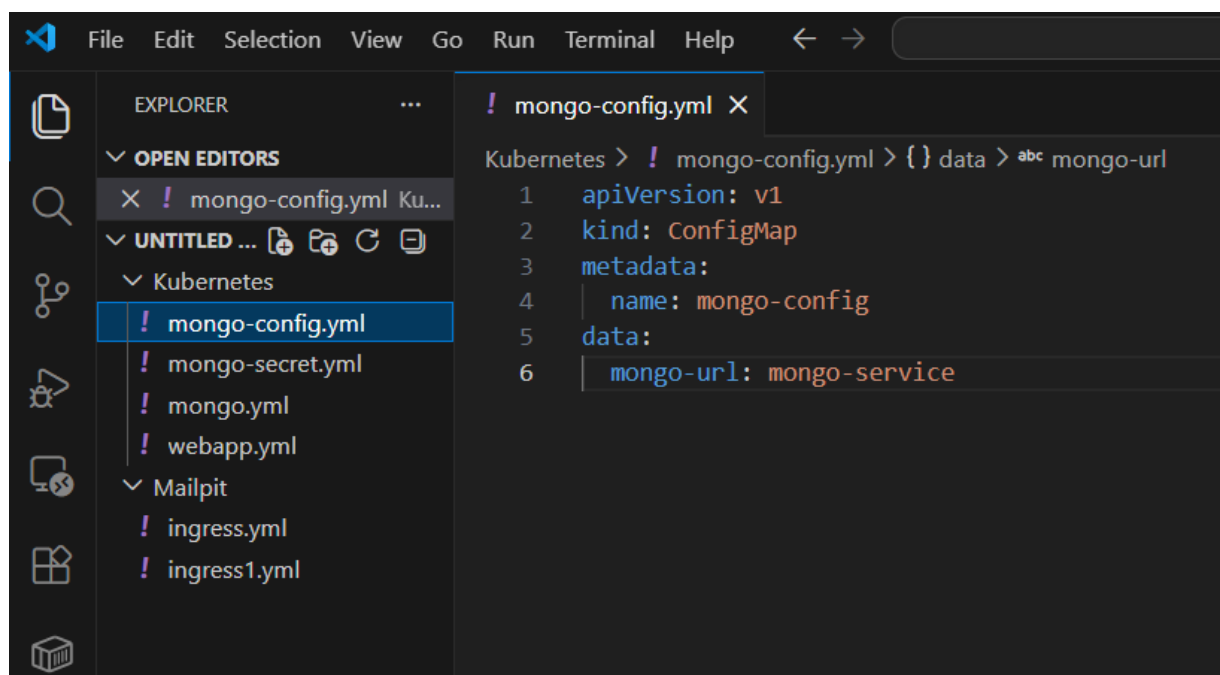
https://www.youtube.com/watch?v=s_o8dwzRlu4



The screenshot shows the Docker Hub page for the repository `nanajanashia/k8s-demo-app`. The page includes the repository name, a description, and a table of tags. The table lists the tag `v1.0`, the digest `6f554135da39`, the OS/ARCH `linux/amd64`, and the compressed size `45.24 MB`. A search bar and a 'Sort by' dropdown are also visible.

TAG	Digest	OS/ARCH	Compressed size
v1.0 Last pushed over 4 years by nanajanashia	6f554135da39	linux/amd64	45.24 MB

Composant de type ConfigMap :



The screenshot shows a VS Code editor window with a file named `mongo-config.yml` open. The file content is a Kubernetes ConfigMap definition:

```
Kubernetes > ! mongo-config.yml > {} data > abc mongo-url
1  apiVersion: v1
2  kind: ConfigMap
3  metadata:
4    name: mongo-config
5  data:
6    mongo-url: mongo-service
```

Composant de type Secret :

```

Kubernetes > ! mongo-secret.yml > {} data > abc mongo-password
1  apiVersion: v1
2  kind: Secret
3  metadata:
4    name: mongo-secret
5  type: Opaque
6  data:
7    mongo-user: bw9uZ291c2Vy
8    mongo-password: bw9uZ29wYXNzd29yZA==

```

Créer un service interne : service qui va permettre la communication entre le pod front et le pod de la base de données

```

Kubernetes > ! mongo.yml > abc apiVersion
32  | | | | | key: mongo-password
33  ---
34  apiVersion: v1
35  kind: Service
36  metadata:
37    name: mongo-service
38  spec:
39    selector:
40      app: mongo
41    ports:
42      - protocol: TCP
43        port: 27017
44        targetPort: 27017

```

Créer un service externe : pod du front accessible depuis l'extérieur du cluster Kubernetes

The image shows a screenshot of the Visual Studio Code editor. The Explorer sidebar on the left shows a project structure with folders for 'Kubernetes' and 'Mailpit'. The 'Kubernetes' folder contains files: 'mongo-config.yml', 'mongo-secret.yml', 'mongo.yml', and 'webapp.yml' (which is selected). The 'Mailpit' folder contains 'ingress.yml' and 'ingress1.yml'. The main editor area displays the content of 'webapp.yml' with the following YAML code:

```
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: webapp-deployment
5    labels:
6      app: webapp
7  spec:
8    replicas: 1
9    selector:
10     matchLabels:
11       app: webapp
12   template:
13     metadata:
14       labels:
15         app: webapp
16     spec:
17       containers:
18         - name: webapp
19           image: nanajanashia/k8s-demo-app:v1.0
20           ports:
21             - containerPort: 3000
22           env:
23             - name: USER_NAME
24               valueFrom:
25                 secretKeyRef:
26                   name: mongo-secret
27                   key: mongo-user
28             - name: USER_PWD
29               valueFrom:
30                 secretKeyRef:
31                   name: mongo-secret
32                   key: mongo-password
33             - name: DB_URL
34               valueFrom:
35                 configMapKeyRef:
36                   name: mongo-config
37                   key: mongo-url
```

Déployer l'application mongo :

```
File Edit Selection View Go Run Terminal Help
EXPLORER
OPEN EDITORS
! mongo.yml Kubernetes
UNTITLED (WORKSPACE)
Kubernetes
! mongo-config.yml
! mongo-secret.yml
! mongo.yml
! webapp.yml
Mailpit
! ingress.yml
! ingress1.yml
OUTLINE
TIMELINE

! mongo.yml X
Kubernetes > ! mongo.yml > abc apiVersion
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   name: mongo-deployment
5   labels:
6     app: mongo
7 spec:
8   replicas: 1
9   selector:
10    matchLabels:
11     app: mongo
12   template:
13     metadata:
14       labels:
15         app: mongo
16     spec:
17       containers:
18       - name: mongodb
19         image: mongodb/mongodb-community-server:latest
20         ports:
21         - containerPort: 27017
22       env:
23       - name: MONGO_INITDB_ROOT_USERNAME
24         valueFrom:
25           secretKeyRef:
26             name: mongo-secret
27             key: mongo-user
28       - name: MONGO_INITDB_ROOT_PASSWORD
29         valueFrom:
30           secretKeyRef:
31             name: mongo-secret
32             key: mongo-password
33 ---
34 apiVersion: v1
35 kind: Service
36 metadata:
37   name: mongo-service
```

Procéder à la création des composants en appliquant la commande `kubectl apply -f` aux 4 fichiers YAML dans l'ordre figurant ci-dessous :

```

! mongo-config.yml > abc apiVersion
1  apiVersion: v1
2  kind: ConfigMap
3  metadata:
4    name: mongo-config
5  data:
6    mongo-url: mongo-service
7
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl apply -f mongo-config.yml
configmap/mongo-config unchanged
PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl apply -f mongo-secret.yml
secret/mongo-secret created
PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl apply -f mongo.yml
deployment.apps/mongo-deployment created
service/mongo-service created
PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl apply -f webapp.yml
deployment.apps/webapp-deployment created
service/webapp-service created
PS C:\Users\phbou\Documents\B1sem4\Kubernetes>

```

Lister les objets créés :

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get all
NAME                                READY   STATUS              RESTARTS   AGE
pod/mongo-deployment-744864fdd7-bnpgx  0/1     ContainerCreating   0           2m37s
pod/webapp-deployment-5766fd95c7-cb4wg  0/1     ContainerCreating   0           2m11s

NAME                                TYPE          CLUSTER-IP      EXTERNAL-IP   PORT(S)          AGE
service/kubernetes                  ClusterIP     10.96.0.1       <none>        443/TCP          2d3h
service/mongo-service               ClusterIP     10.108.31.5     <none>        27017/TCP        2m37s
service/webapp-service              NodePort      10.104.147.146 <none>        3000:30100/TCP  2m11s

NAME                                READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/mongo-deployment     0/1     1             0           2m37s
deployment.apps/webapp-deployment    0/1     1             0           2m11s

NAME                                DESIRED   CURRENT   READY   AGE
replicaset.apps/mongo-deployment-744864fdd7  1         1         0       2m37s
replicaset.apps/webapp-deployment-5766fd95c7  1         1         0       2m11s
PS C:\Users\phbou\Documents\B1sem4\Kubernetes>

```

Lister les autres objets (configMap et Secret) :

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get configmap

NAME          DATA  AGE
kube-root-ca.crt  1     2d3h
mongo-config   1     25m
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get secret
NAME          TYPE      DATA  AGE
mongo-secret  Opaque    2      6m57s
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> |
```

Décrire le service webapp-service :

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl describe service webapp-service
Name:          webapp-service
Namespace:     default
Labels:        <none>
Annotations:   <none>
Selector:      app=webapp
Type:          NodePort
IP Family Policy: SingleStack
IP Families:   IPv4
IP:            10.104.147.146
IPs:           10.104.147.146
Port:          <unset> 3000/TCP
TargetPort:    3000/TCP
NodePort:     <unset> 30100/TCP
Endpoints:     10.244.0.8:3000
Session Affinity: None
External Traffic Policy: Cluster
Internal Traffic Policy: Cluster
Events:        <none>
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> |
```

Décrire le pod associé :

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl describe pod webapp-deployment-5766fd95c7-cb4wg
Name: webapp-deployment-5766fd95c7-cb4wg
Namespace: default
Priority: 0
Service Account: default
Node: minikube/172.24.254.27
Start Time: Sun, 26 Apr 2026 15:26:57 +0200
Labels: app=webapp
pod-template-hash=5766fd95c7
Annotations: <none>
Status: Running
IP: 10.244.0.8
IPs:
IP: 10.244.0.8
Controlled By: ReplicaSet/webapp-deployment-5766fd95c7
Containers:
  webapp:
    Container ID: docker://fe054eab81a00e84b465e70a315993f1bd5017285034a662a92d833e1588724c
    Image: nanajanashia/k8s-demo-app:v1.0
    Image ID: docker-pullable://nanajanashia/k8s-demo-app@sha256:6f554135da39ac00a1c2f43e44c2b0b54ca13d3d8044da969361e7781adb7f95
    Port: 3000/TCP
    Host Port: 0/TCP
    State: Running
      Started: Sun, 26 Apr 2026 15:31:53 +0200
    Ready: True
    Restart Count: 0
    Environment:
      USER_NAME: <set to the key 'mongo-user' in secret 'mongo-secret'> Optional: false
      USER_PWD: <set to the key 'mongo-password' in secret 'mongo-secret'> Optional: false
      DB_URL: <set to the key 'mongo-url' of config map 'mongo-config'> Optional: false
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-9nwkk (ro)
Conditions:
  Type Status
  PodReadyToStartContainers True
  Initialized True
  Ready True
  ContainersReady True
  PodScheduled True
Volumes:
  kube-api-access-9nwkk:

```

Consulter les logs de ce pod :

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get pod
NAME READY STATUS RESTARTS AGE
mongo-deployment-744864fdd7-bnpgx 1/1 Running 0 16m
webapp-deployment-5766fd95c7-cb4wg 1/1 Running 0 15m
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl logs webapp-deployment-5766fd95c7-cb4wg
app listening on port 3000!
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl logs webapp-deployment-5766fd95c7-cb4wg -f
app listening on port 3000!

```

Lister les services :

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get service
NAME TYPE CLUSTER-IP EXTERNAL-IP PORT(S) AGE
kubernetes ClusterIP 10.96.0.1 <none> 443/TCP 2d3h
mongo-service ClusterIP 10.108.31.5 <none> 27017/TCP 17m
webapp-service NodePort 10.104.147.146 <none> 3000:30100/TCP 17m
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes>

```

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> minikube ip
172.24.254.27
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> █
```

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get node
NAME STATUS ROLES AGE VERSION
minikube Ready control-plane 2d3h v1.35.1
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get node -o wide
NAME STATUS ROLES AGE VERSION INTERNAL-IP EXTERNAL-IP OS-IMAGE KERNEL-VERSION CONTAINER-RUNTIME
minikube Ready control-plane 2d3h v1.35.1 172.24.254.27 <none> Buildroot 2025.02 6.6.95 docker://28.5.2
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> █
```

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get svc -o wide
NAME TYPE CLUSTER-IP EXTERNAL-IP PORT(S) AGE SELECTOR
kubernetes ClusterIP 10.96.0.1 <none> 443/TCP 2d3h <none>
mongo-service ClusterIP 10.108.31.5 <none> 27017/TCP 23m app=mongo
webapp-service NodePort 10.104.147.146 <none> 3000:30100/TCP 22m app=webapp
● PS C:\Users\phbou\Documents\B1sem4\Kubernetes> kubectl get pod -o wide
NAME READY STATUS RESTARTS AGE IP NODE NOMINATED NODE READINESS GATES
mongo-deployment-744864fdd7-bnpgx 1/1 Running 0 24m 10.244.0.7 minikube <none> <none>
webapp-deployment-5766fd95c7-cb4wg 1/1 Running 0 23m 10.244.0.8 minikube <none> <none>
○ PS C:\Users\phbou\Documents\B1sem4\Kubernetes> █
```

User profile



Name: **Anna Smith**

Email: **anna.smith@example.com**

Interests: **coding**

Edit Profile

User profile



Name:

Email:

Interests:

User profile



Name: **Maximus le cinquième**

Email:

Interests: **DEVOPS**

Edit Profile

6. Application.

<https://kubernetes.io/docs/tutorials/stateful-application/mysql-wordpress-persistent-volume/>

<https://www.juliafmorgado.com/fr/posts/d%C3%A9ploiement-de-wordpress-et-mysql-sur-kubernetes-avec-kind-guide-%C3%A9tape-par-%C3%A9tape/>

<https://medium.com/@ogo.ulrich/d%C3%A9ploiement-de-wordpress-avec-mysql-sur-kubernetes-46d6e1e7755c>

<https://medium.com/@dipakrasal2009/deploying-wordpress-on-kubernetes-minikube-using-wordpress-and-mysql-docker-images-21b170972b34>

- ➔ Déployer un blog WordPress et sa base de données MySQL en utilisant Minikube. Automatiser le déploiement avec des fichiers YAML et utiliser pour cela les objets PersistentVolumes et PersistentVolumeClaims afin d'être indépendant du cycle de vie des Pod et ainsi préserver les données en cas de redémarrage ou de suppression de Pods.

7. Suite Ingress (Mailpit) : hôtes virtuels et nom de domaine nip.io

- Récupérer les informations sur les objets ingress :

```
Administrateur : Windows Po x + v - □ ×
PS C:\Users\phbou> kubectl get ingress
NAME                CLASS   HOSTS   ADDRESS          PORTS   AGE
test-ingress-mailpit  nginx  *      172.27.68.223   80      45s
PS C:\Users\phbou> minikube ip
172.27.68.223
PS C:\Users\phbou> |
```

L'étoile indique que le contrôleur utilise Mailpit par défaut pour toutes les requêtes entrantes : tous les accès sont renvoyés vers Mailpit.

Dans une règle Ingress, le champ host permet de spécifier le nom de l'hôte virtuel. Il faut pour cela disposer d'un nom de domaine et d'une entrée DNS (mailpit.sio-exupery.fr par exemple).

Dans notre cas, nous ne disposons que d'une adresse IP.

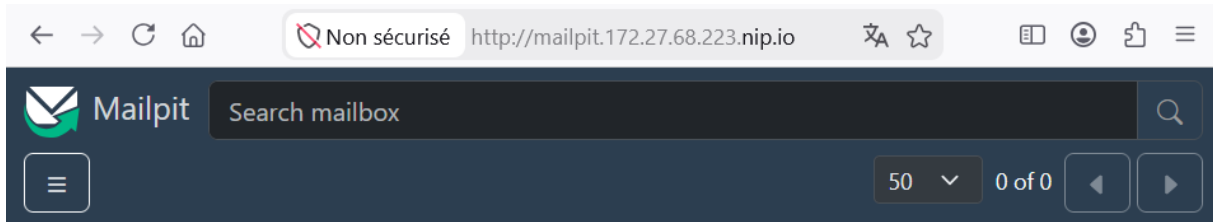
- ➔ Nous pouvons utiliser le mécanisme nip.io qui utilise le domaine 172.27.68.223.nip.io et tous ses sous-domaines (mailpit.172.27.68.223.nip.io par exemple).
- Création d'un hôte virtuel pour Mailpit : modification du contenu du fichier ingress.yaml afin de pointer la règle Ingress sur l'entrée DNS figurant ci-dessus :

```
File Edit Selection View Go Run Terminal Help ← → Mailpit [Administrator]
EXPLORER
OPEN EDITORS
! ingress2.yaml
MAILPIT
! ingress.yaml
! ingress1.yaml
! ingress2.yaml
! ingress2.yaml x
! ingress2.yaml > {} metadata > abc name
1 apiVersion: networking.k8s.io/v1
2 kind: Ingress
3 metadata:
4   name: mailpit-ingress
5 spec:
6   rules:
7     - host: "mailpit.172.27.68.223.nip.io"
8     http:
9       paths:
10        - path: /
11          pathType: Prefix
12          backend:
13            service:
14              name: mailpit
15              port:
16                number: 8025
```

- Prise en compte de la modification :

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
• PS C:\Users\phbou\Documents\B1sem4\Mailpit> kubectl apply -f ingress2.yml
ingress.networking.k8s.io/mailpit-ingress created
○ PS C:\Users\phbou\Documents\B1sem4\Mailpit
```

- Tester le mécanisme de publication reposant sur un hôte virtuel :



No messages in your mailbox

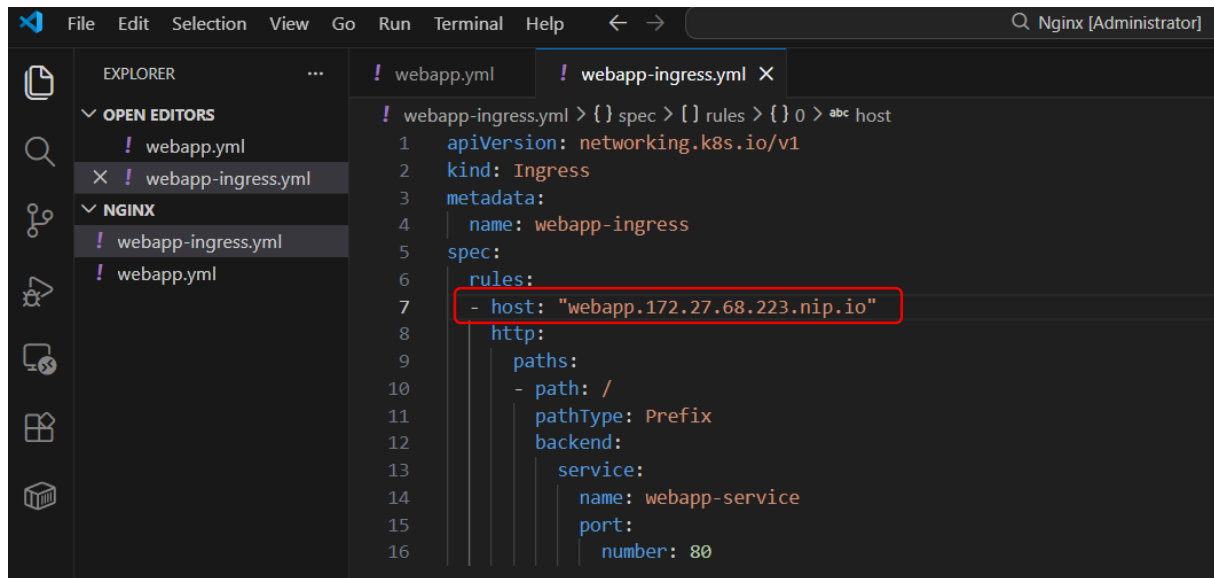
8. Hôtes virtuels et nom de domaine nip.io : autre exemple

- Créer un objet Deployment et un objet Service :

```
File Edit Selection View Go Run Terminal Help Nginx [Administrator]
EXPLORER
OPEN EDITORS
! webapp.yml
! webapp-ingress.yml
NGINX
! webapp-ingress.yml
! webapp.yml

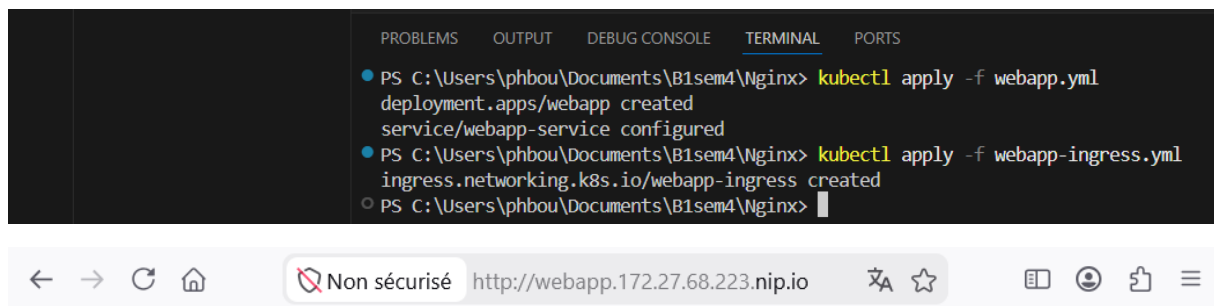
! webapp.yml X ! webapp-ingress.yml
! webapp.yml > {} spec > {} ports > {} 0 > # targetPort
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: webapp
5  spec:
6    replicas: 2
7    selector:
8      matchLabels:
9        app: webapp
10   template:
11     metadata:
12       labels:
13         app: webapp
14     spec:
15       containers:
16         - name: webapp
17           image: nginx:latest
18           ports:
19             - containerPort: 80
20   ---
21   apiVersion: v1
22   kind: Service
23   metadata:
24     name: webapp-service
25   spec:
26     selector:
27       app: webapp
28     ports:
29       - protocol: TCP
30         port: 80
31     targetPort: 80
```

- Créer un objet Ingress avec le champ host spécifiant le nom d'hôte virtuel `webapp.172.27.68.223.nip.io` :

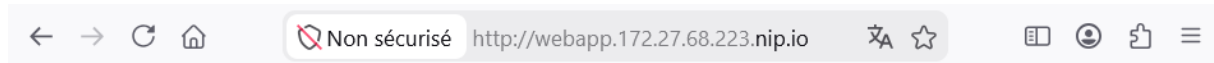


```
! webapp-ingress.yml > {} spec > [] rules > {} 0 > abc host
1  apiVersion: networking.k8s.io/v1
2  kind: Ingress
3  metadata:
4    name: webapp-ingress
5  spec:
6    rules:
7    - host: "webapp.172.27.68.223.nip.io"
8      http:
9        paths:
10         - path: /
11           pathType: Prefix
12         backend:
13           service:
14             name: webapp-service
15             port:
16               number: 80
```

- Prise en compte de 2 fichiers YAML et test :



```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
• PS C:\Users\phbou\Documents\B1sem4\Nginx> kubectl apply -f webapp.yaml
deployment.apps/webapp created
service/webapp-service configured
• PS C:\Users\phbou\Documents\B1sem4\Nginx> kubectl apply -f webapp-ingress.yaml
ingress.networking.k8s.io/webapp-ingress created
○ PS C:\Users\phbou\Documents\B1sem4\Nginx> |
```



Welcome to nginx!

If you see this page, nginx is successfully installed and working. Further configuration is required for the web server, reverse proxy, API gateway, load balancer, content cache, or other features.

For online documentation and support please refer to nginx.org.
To engage with the community please visit community.nginx.org.
For enterprise grade support, professional services, additional security features and capabilities please refer to f5.com/nginx.

Thank you for using nginx.

- ➔ Nous aurions pu créer un seul objet Ingress routant plusieurs domaines vers différents Services.

9. Cycle de vie d'un conteneur dans Kubernetes

- Consulter l'état des pods de l'application portant le labell `app=mailpit` :

```
Administrateur : Windows Po... x + v - □ ×
PS C:\Users\phbou> kubectl get pods -l app=mailpit
NAME                                READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-qb9pg           1/1    Running   0           143m
mailpit-7b96b48c5d-rxwwl           1/1    Running   0           152m
PS C:\Users\phbou>
```

- Connexion au pod (indiquer le nom du pod ou le nom du déploiement). Une fois dans le contexte du conteneur de Mailpit, lister les processus, créer un répertoire, lister le répertoire (et non pas son contenu) puis tuer le processus Mailpit :

```
Administrateur : Windows Po... x + v - □ ×
PS C:\Users\phbou> kubectl exec -it deployment/mailpit -- sh
/# ps -ef
PID    USER     TIME   COMMAND
  1  root      0:00  /mailpit
 22  root      0:00  sh
 28  root      0:00  ps -ef
/# mkdir /tmp/test
/# ls -ld /tmp/test
drwxr-xr-x  2 root    root    4096 May  4 11:11 /tmp/test
/# kill 1
/# command terminated with exit code 137
PS C:\Users\phbou>
```

- Consulter l'état des pods de l'application :

```
Administrateur : Windows Po... x + v - □ ×
PS C:\Users\phbou> kubectl get pods -l app=mailpit
NAME                                READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-qb9pg           1/1    Running   0           148m
mailpit-7b96b48c5d-rxwwl           1/1    Running   1 (45s ago)  157m
PS C:\Users\phbou>
```

Le pod a redémarré automatiquement. Il s'agit d'un nouveau pod. Le conteneur n'est plus le même.

- Lancer à nouveau une connexion sur le conteneur Mailpit. Le répertoire /tmp/test n'est plus présent :

```
Administrateur : Windows Po... x + v - □ ×
PS C:\Users\phbou> kubectl exec -it deployment/mailpit -- sh
/# ls -ld /tmp/test
ls: /tmp/test: No such file or directory
/# exit
command terminated with exit code 1
PS C:\Users\phbou>
```

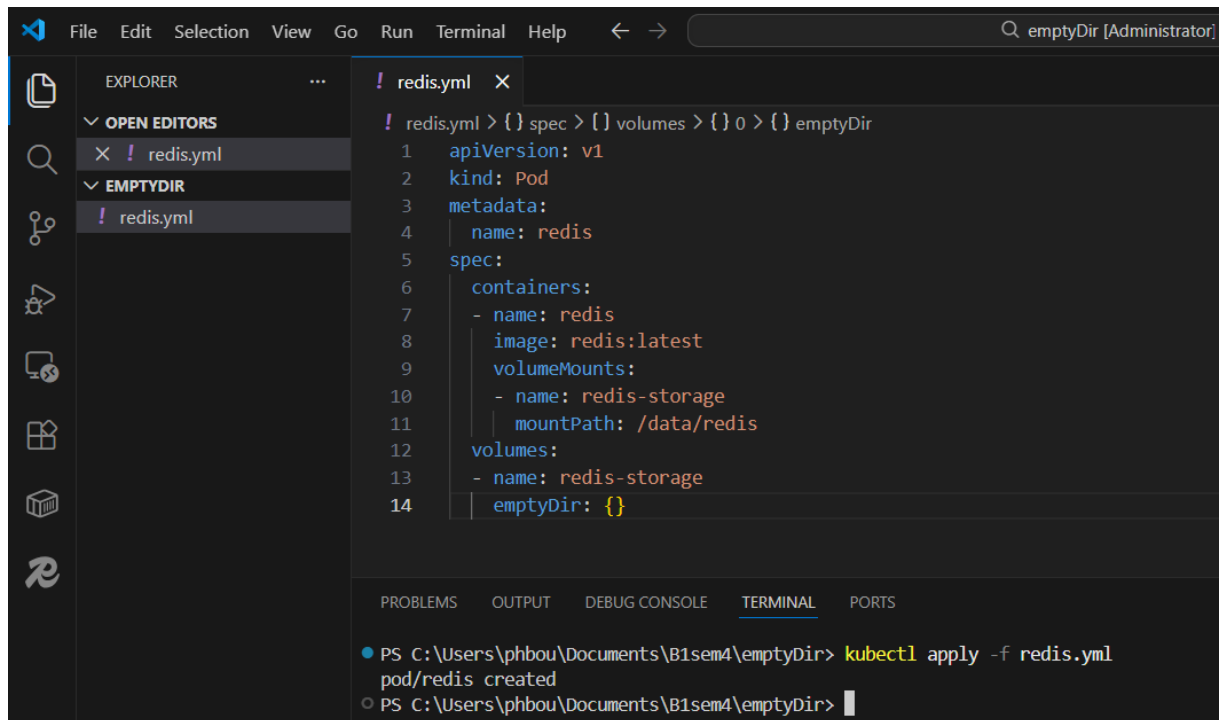
10. Persistance des données

1) Volume de type emptyDir

Un Volume de type emptyDir est un volume temporaire liée au cycle de vie du Pod. Il dure toute la vie du Pod même si le conteneur s'arrête et redémarre.

Exemple avec Redis :

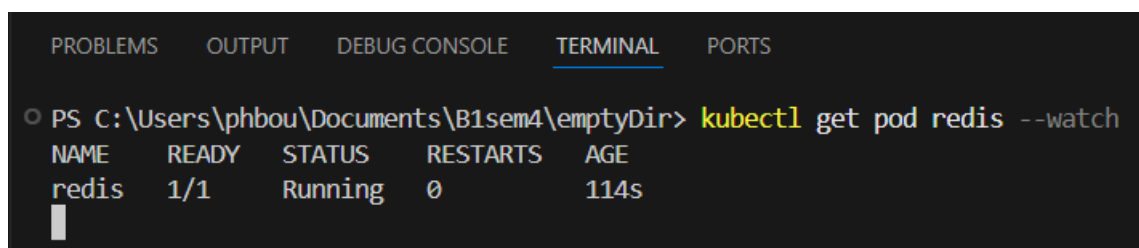
- Créer le fichier de configuration du Pod redis.yaml et créer le pod avec la commande kubectl apply -f :



```
! redis.yaml > { } spec > { } volumes > { } 0 > { } emptyDir
1  apiVersion: v1
2  kind: Pod
3  metadata:
4    name: redis
5  spec:
6    containers:
7      - name: redis
8        image: redis:latest
9        volumeMounts:
10       - name: redis-storage
11         mountPath: /data/redis
12    volumes:
13      - name: redis-storage
14        emptyDir: { }
```

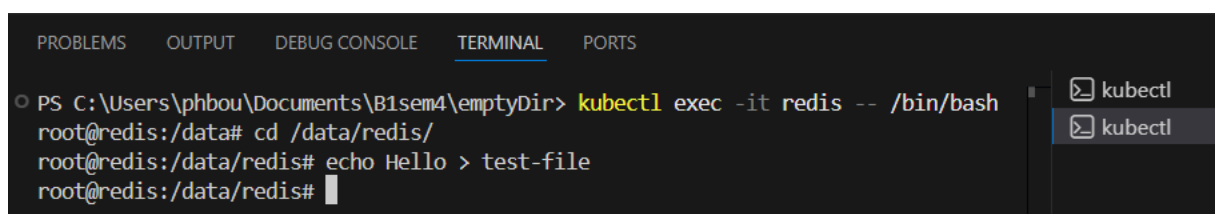
```
PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl apply -f redis.yaml
pod/redis created
PS C:\Users\phbou\Documents\B1sem4\emptyDir>
```

- Vérifier que le conteneur du pod soit en cours d'exécution puis surveiller les modifications apportées au pod :



```
PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl get pod redis --watch
NAME      READY   STATUS    RESTARTS   AGE
redis    1/1     Running   0           114s
```

- Dans un second terminal, accéder à la console shell du conteneur en cours d'exécution puis créer un fichier dans /data/redis/ :

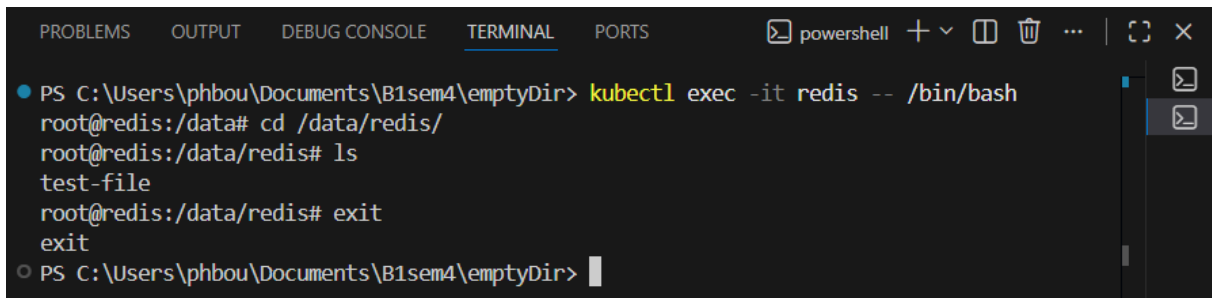


```
PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl exec -it redis -- /bin/bash
root@redis:/data# cd /data/redis/
root@redis:/data/redis# echo Hello > test-file
root@redis:/data/redis#
```

- Installer procs (faire un apt-get update au préalable) puis lister les processus en cours d'exécution :

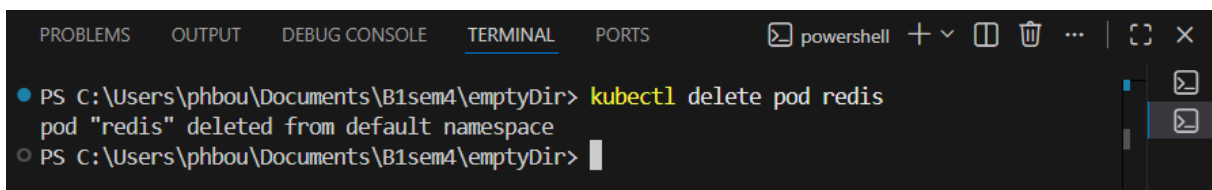
Le conteneur est terminé et redémarré.

- Accéder à la console shell du conteneur redémarré et constater que le fichier test-file est toujours présent dans le répertoire /data/redis :

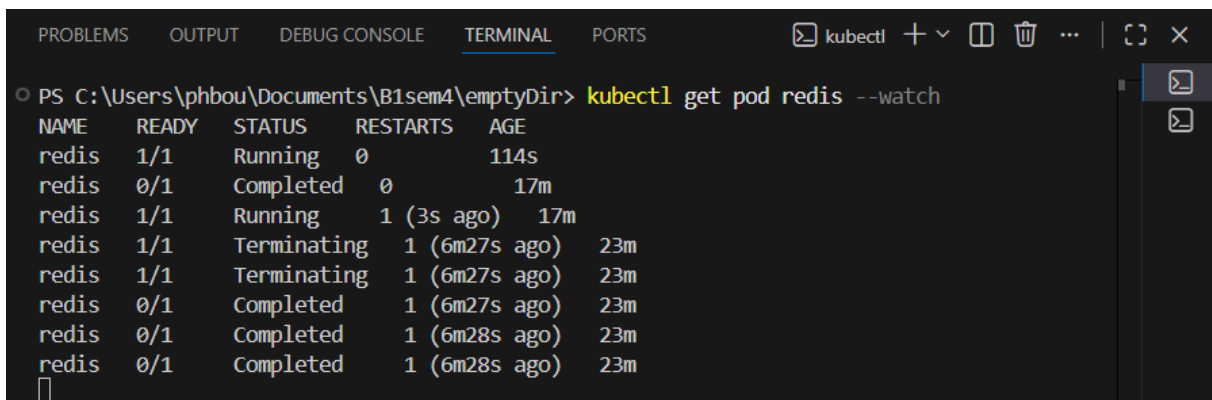


```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell + - [ ] [ ] ... | [ ] [ ] [ ] X
● PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl exec -it redis -- /bin/bash
root@redis:/data# cd /data/redis/
root@redis:/data/redis# ls
test-file
root@redis:/data/redis# exit
exit
○ PS C:\Users\phbou\Documents\B1sem4\emptyDir> |
```

- Supprimer le pod :



```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell + - [ ] [ ] ... | [ ] [ ] [ ] X
● PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl delete pod redis
pod "redis" deleted from default namespace
○ PS C:\Users\phbou\Documents\B1sem4\emptyDir> |
```



```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS kubectl + - [ ] [ ] ... | [ ] [ ] [ ] X
○ PS C:\Users\phbou\Documents\B1sem4\emptyDir> kubectl get pod redis --watch
NAME READY STATUS RESTARTS AGE
redis 1/1 Running 0 114s
redis 0/1 Completed 0 17m
redis 1/1 Running 1 (3s ago) 17m
redis 1/1 Terminating 1 (6m27s ago) 23m
redis 1/1 Terminating 1 (6m27s ago) 23m
redis 0/1 Completed 1 (6m27s ago) 23m
redis 0/1 Completed 1 (6m28s ago) 23m
redis 0/1 Completed 1 (6m28s ago) 23m
|
```

2) Volume de type PV (PersistentVolume) et PVC (PersistentVolumeClaim)

- Accéder à minikube via la commande minikube ssh puis créer un dossier /mnt/data. Dans le dossier /mnt/data, créer un fichier index.html. Tester l'existence du fichier index.html puis fermer la session shell sur le nœud du cluster.

- Créer un PersistentVolumeClaim (demande de stockage)

Les Pods utilisent les PersistentVolumeClaims pour demander un accès à du stockage physique.

```
! pvc-nginx.yml > {} spec > abc volumeName
1  apiVersion: v1
2  kind: PersistentVolumeClaim
3  metadata:
4    name: task-pv-claim
5  spec:
6    storageClassName: manual
7    accessModes:
8      - ReadWriteOnce
9    resources:
10     requests:
11       storage: 10Mi
12     volumeName: pv-nginx
```

```
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl apply -f pvc-nginx.yml
persistentvolumeclaim/task-pv-claim created
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume>
```

```
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl get pv pv-nginx
```

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM	STORAGECLASS	VOLUMEATTRIBUTESCLASS	REASON
pv-nginx	10Mi	RWO	Retain	Bound	default/task-pv-claim	manual	<unset>	

```
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume>
```

```
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl get pvc
```

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE
task-pv-claim	Bound	pv-nginx	10Mi	RWO	manual	<unset>	119s

```
PS C:\Users\phbou\Documents\B1sem4\PersistentVolume>
```

- Créer un Pod qui utilise le PersistentVolumeClaim comme volume de stockage

The screenshot shows the Visual Studio Code editor with three files open: pvc-nginx.yml, pvc-pod.yml, and pv-nginx.yml. The pvc-pod.yml file is selected and displays the following YAML content:

```

1  apiVersion: v1
2  kind: Pod
3  metadata:
4    name: task-pv-pod
5  spec:
6    volumes:
7      - name: task-pv-storage
8        persistentVolumeClaim:
9          claimName: task-pv-claim
10   containers:
11     - name: task-pv-container
12       image: nginx:latest
13       ports:
14         - containerPort: 80
15           name: "http-server"
16       volumeMounts:
17         - mountPath: "/usr/share/nginx/html"
18           name: task-pv-storage

```

The terminal window at the bottom shows the command `kubectl apply -f pvc-pod.yml` being executed, resulting in the output: `pod/task-pv-pod created`.

The screenshot shows a PowerShell terminal window with the following output:

```

PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl get pod task-pv-pod
NAME          READY   STATUS             RESTARTS   AGE
task-pv-pod   0/1    ContainerCreating   0           39s

PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl describe pod task-pv-pod
Name:          task-pv-pod
Namespace:     default
Priority:       0
Service Account: default
Node:          minikube/172.22.17.143
Start Time:    Tue, 05 May 2026 20:20:24 +0200
Labels:        <none>
Annotations:   <none>
Status:        Pending
IP:            <none>
IPs:          <none>

```

The screenshot shows a PowerShell terminal window with the following output:

```

PS C:\Users\phbou\Documents\B1sem4\PersistentVolume> kubectl get pod task-pv-pod
NAME          READY   STATUS    RESTARTS   AGE
task-pv-pod   1/1    Running   0           7m42s

PS C:\Users\phbou\Documents\B1sem4\PersistentVolume>

```