Chap5 : Kubernetes : plateforme de déploiement des applications conteneurisées

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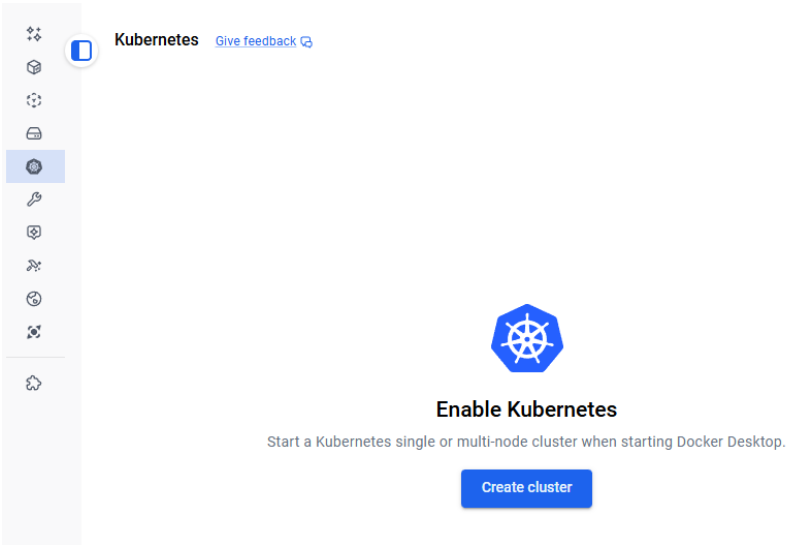
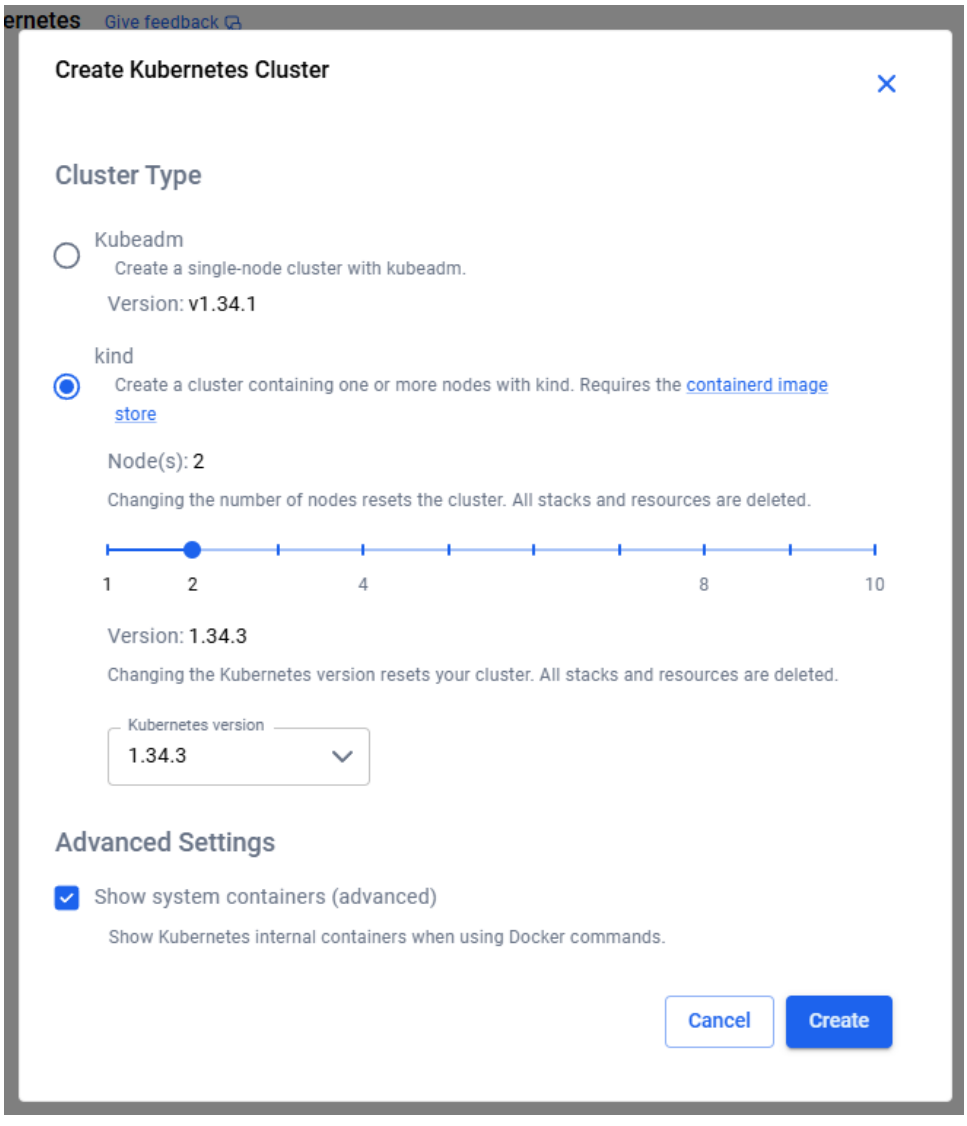
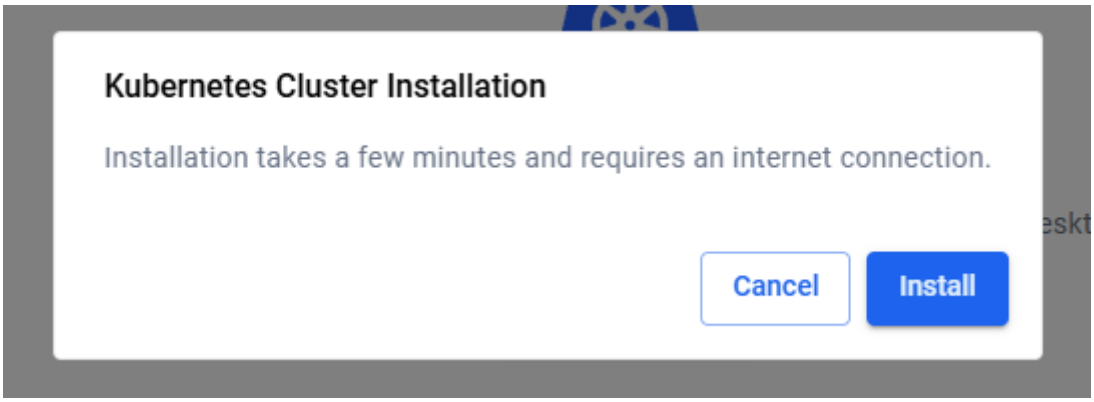
1 – Kubernetes avec Docker Desktop :

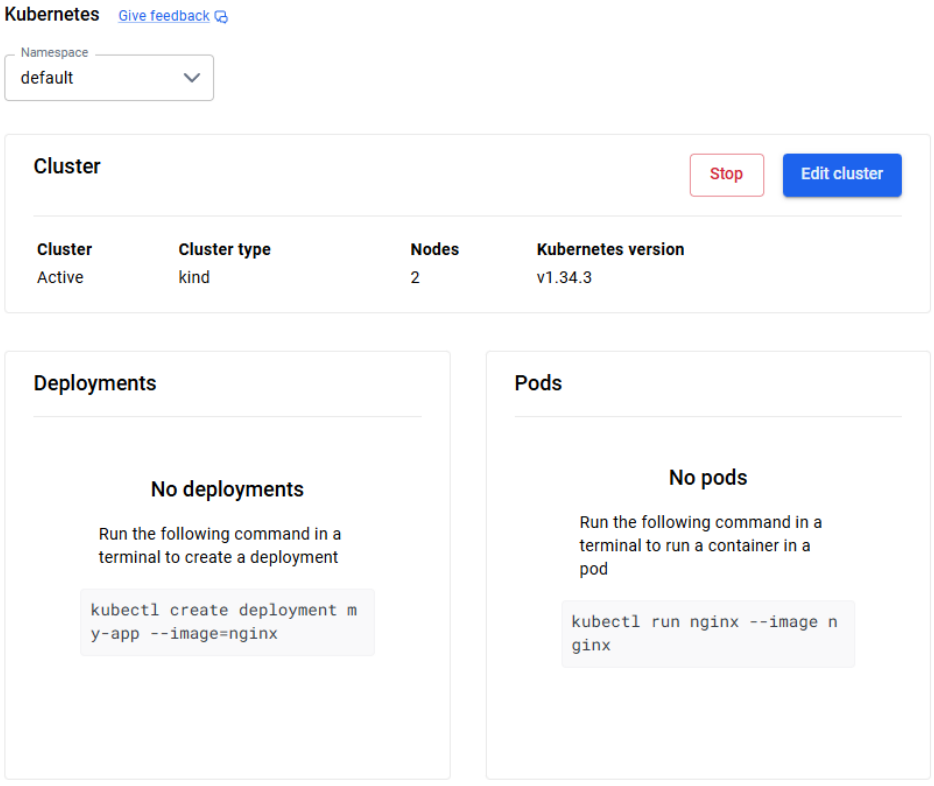
- J'active kubernetes :

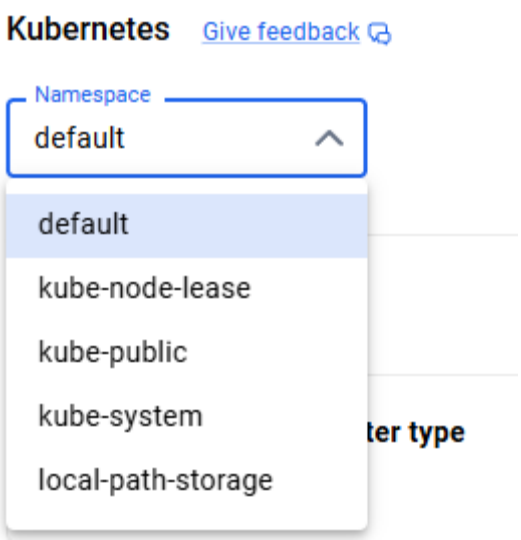


- Je choisis kind et je mets deux nœuds :

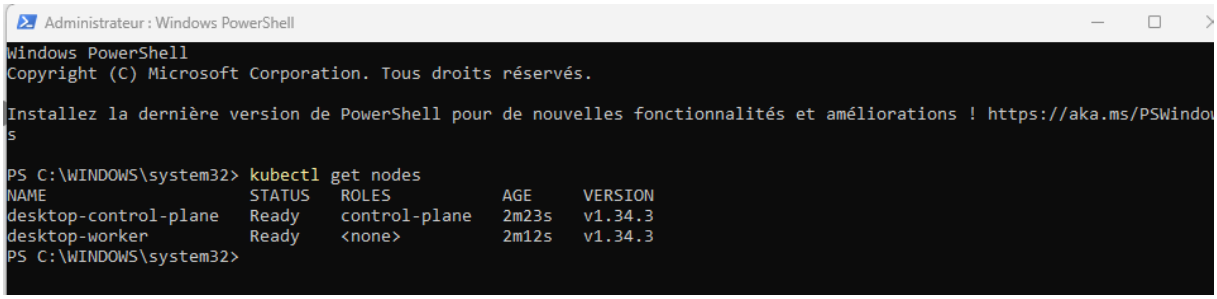



Kubernetes Cluster Installation
Installation takes a few minutes and requires an internet connection.
Cancel
Install

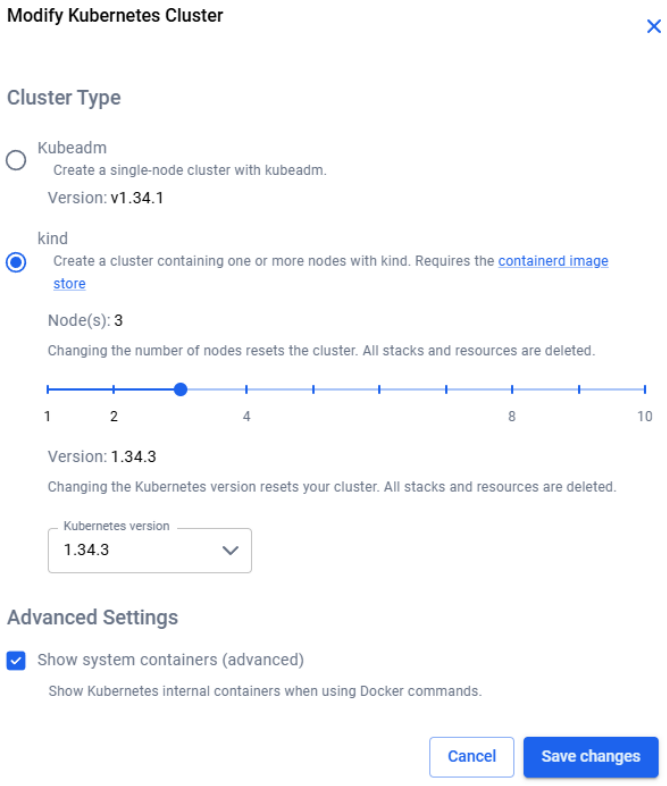

Kubernetes
Give feedback
Namespace
default
Cluster
Stop
Edit cluster
Cluster
Active
Cluster type
kind
Nodes
2
Kubernetes version
v1.34.3
Deployments
No deployments
Run the following command in a terminal to create a deployment
kubectl create deployment my-app --image=nginx
Pods
No pods
Run the following command in a terminal to run a container in a pod
kubectl run nginx --image nginx

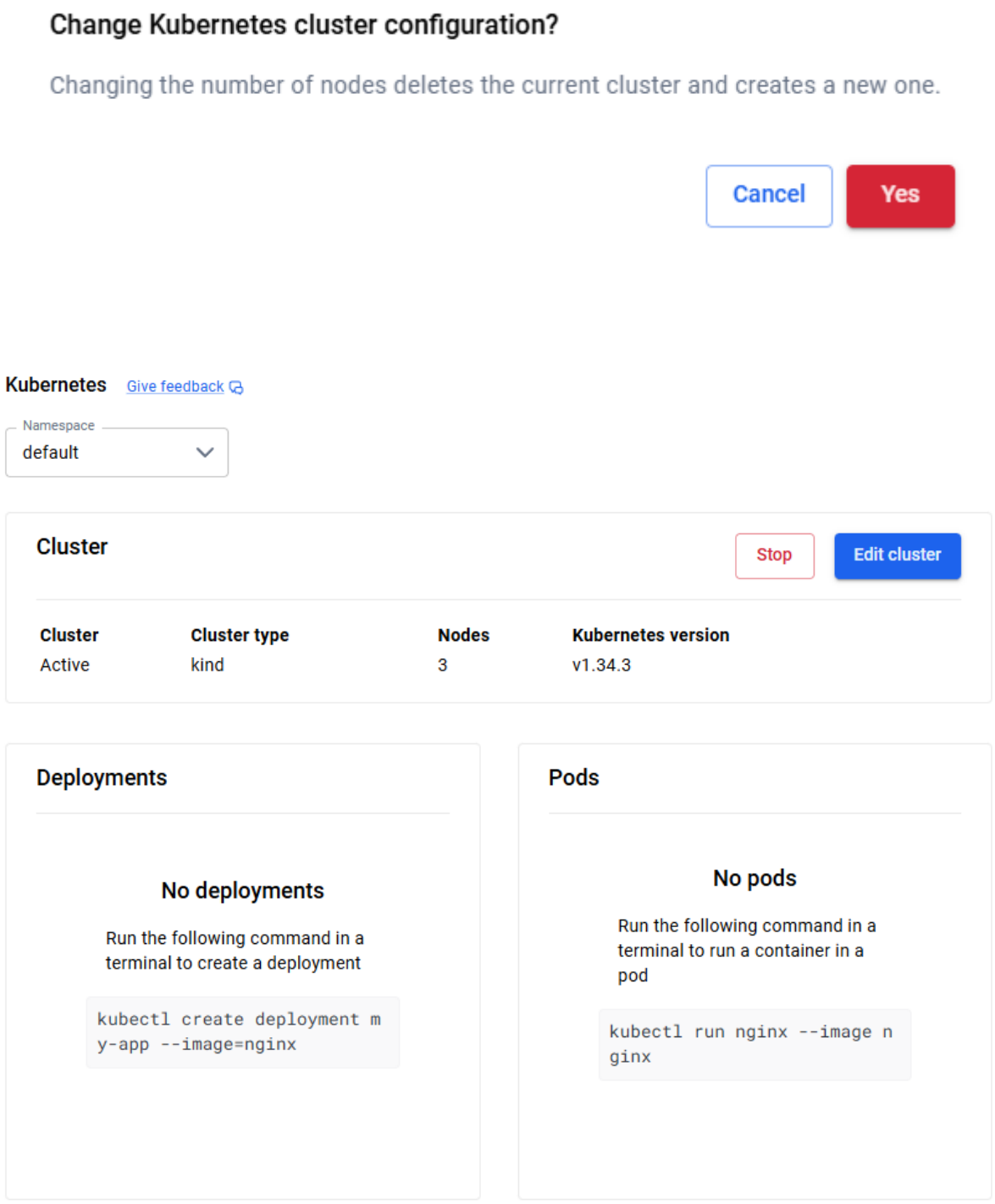


- 2 noeuds



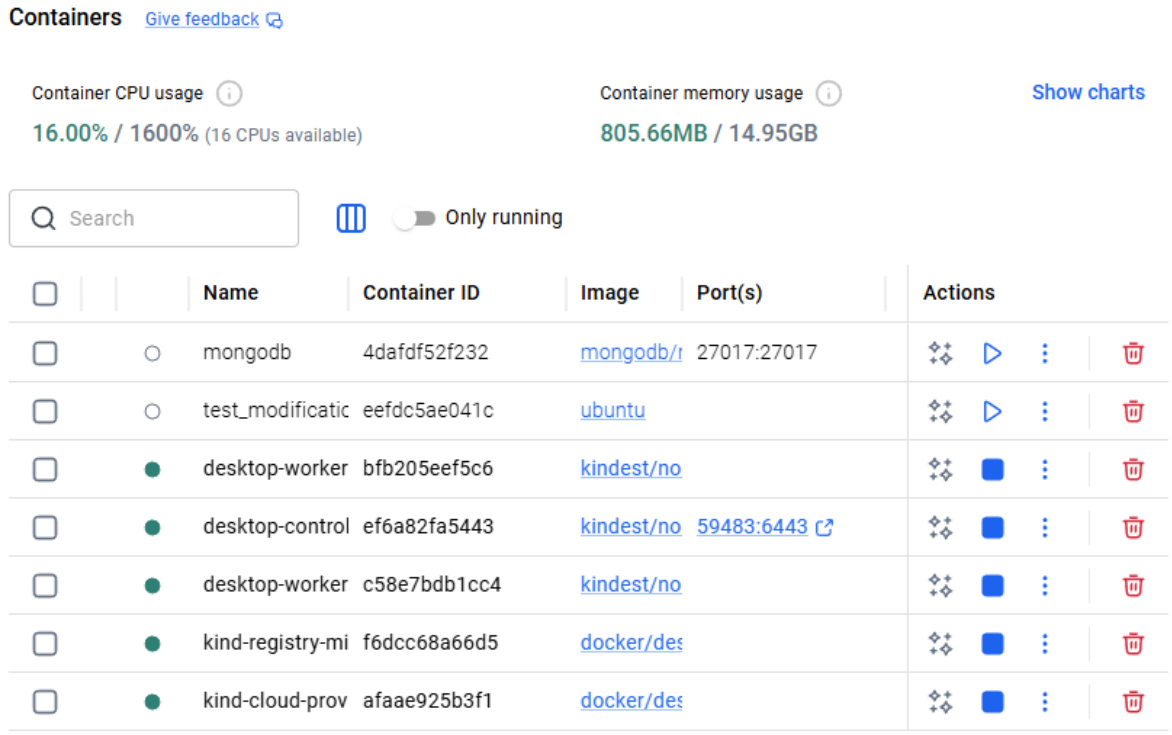
- J'augmente à 3 nœuds :




Change Kubernetes cluster configuration?
Changing the number of nodes deletes the current cluster and creates a new one.
Cancel
Yes
Kubernetes
Give feedback
Namespace
default
Cluster
Stop
Edit cluster
Cluster
Active
Cluster type
kind
Nodes
3
Kubernetes version
v1.34.3
Deployments
No deployments
Run the following command in a terminal to create a deployment
kubectl create deployment my-app --image=nginx
Pods
No pods
Run the following command in a terminal to run a container in a pod
kubectl run nginx --image nginx

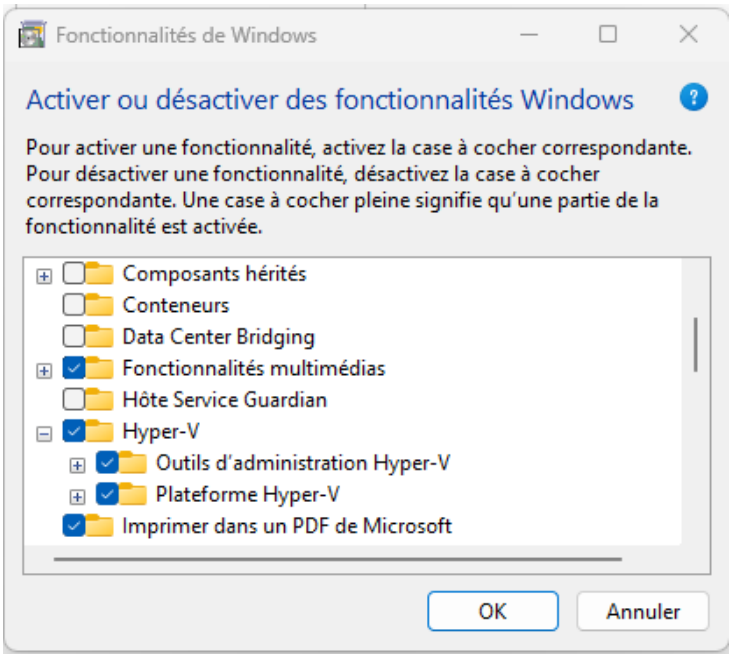
- Je vois bien les 3 nœuds :

```
PS C:\WINDOWS\system32> kubectl get nodes
NAME                   STATUS   ROLES           AGE   VERSION
desktop-control-plane   Ready    control-plane   56s   v1.34.3
desktop-worker          Ready    <none>          41s   v1.34.3
desktop-worker2         Ready    <none>          41s   v1.34.3
PS C:\WINDOWS\system32>
```

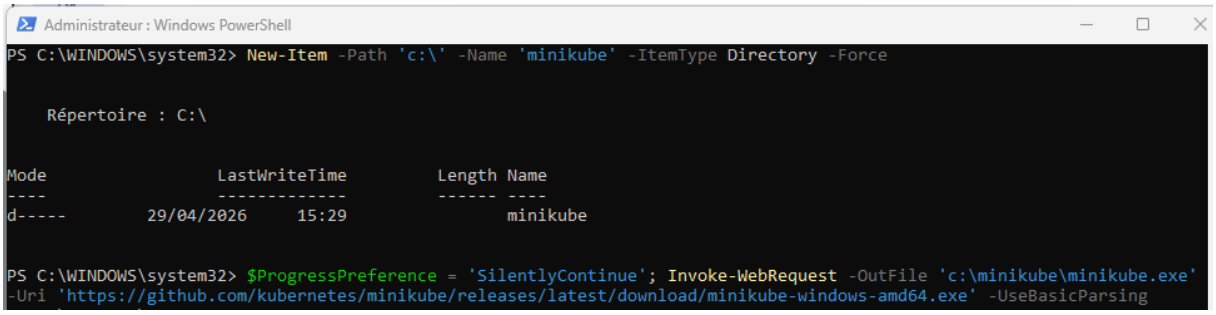


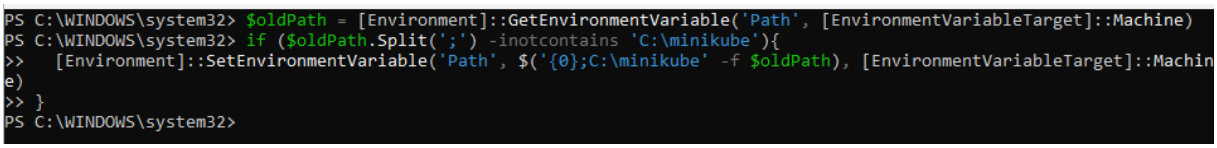
2 – Installation de minikube :

- J'active la fonctionnalité Hyper-V :

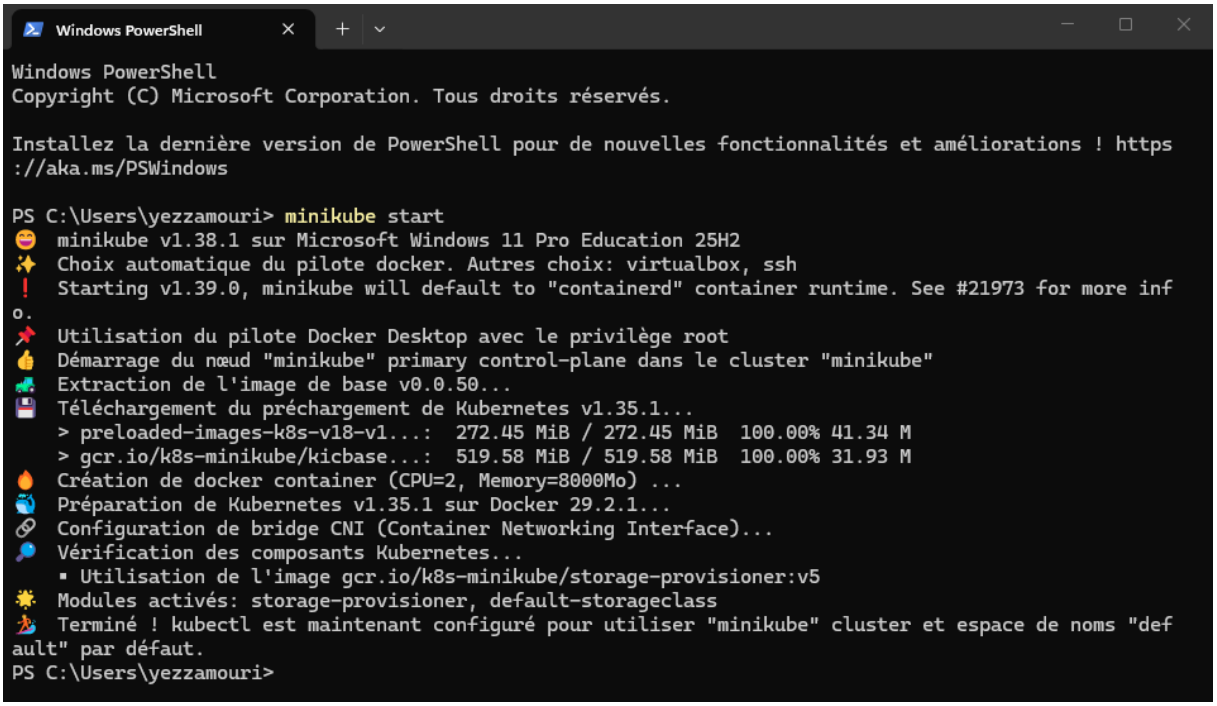


- J'installe minikube :

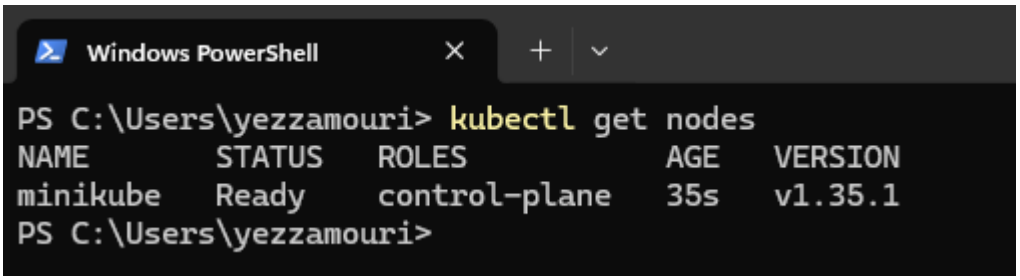




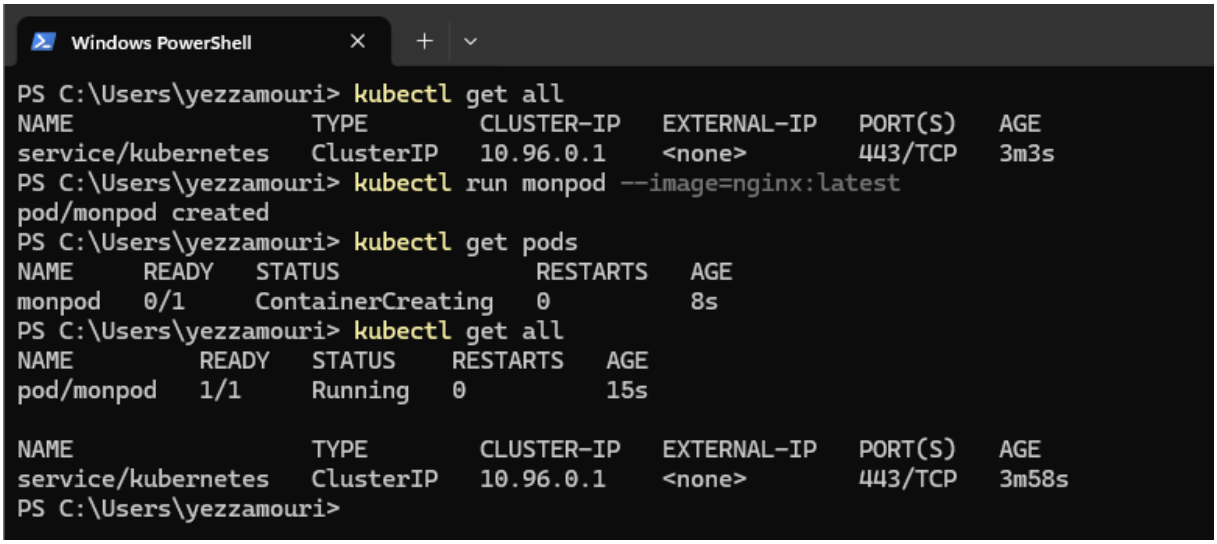
- Je start minikube :



- J'affiche les nœuds :



- Je liste les objets :



- Je Consulte le log d'un pod :

```
PS C:\Users\yezzamouri> 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
2026/04/29 13:38:41 [notice] 1#1: using the "epoll" event method
2026/04/29 13:38:41 [notice] 1#1: nginx/1.29.8
2026/04/29 13:38:41 [notice] 1#1: built by gcc 14.2.0 (Debian 14.2.0-19)
2026/04/29 13:38:41 [notice] 1#1: OS: Linux 6.6.87.2-microsoft-standard-WSL2
2026/04/29 13:38:41 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2026/04/29 13:38:41 [notice] 1#1: start worker processes
2026/04/29 13:38:41 [notice] 1#1: start worker process 29
2026/04/29 13:38:41 [notice] 1#1: start worker process 30
2026/04/29 13:38:41 [notice] 1#1: start worker process 31
2026/04/29 13:38:41 [notice] 1#1: start worker process 32
2026/04/29 13:38:41 [notice] 1#1: start worker process 33
2026/04/29 13:38:41 [notice] 1#1: start worker process 34
2026/04/29 13:38:41 [notice] 1#1: start worker process 35
2026/04/29 13:38:41 [notice] 1#1: start worker process 36
2026/04/29 13:38:41 [notice] 1#1: start worker process 37
2026/04/29 13:38:41 [notice] 1#1: start worker process 38
2026/04/29 13:38:41 [notice] 1#1: start worker process 39
2026/04/29 13:38:41 [notice] 1#1: start worker process 40
2026/04/29 13:38:41 [notice] 1#1: start worker process 41
2026/04/29 13:38:41 [notice] 1#1: start worker process 42
2026/04/29 13:38:41 [notice] 1#1: start worker process 43
2026/04/29 13:38:41 [notice] 1#1: start worker process 44
PS C:\Users\yezzamouri>
```

- J'affiche les espaces de noms dans lesquels sont créés les objets :

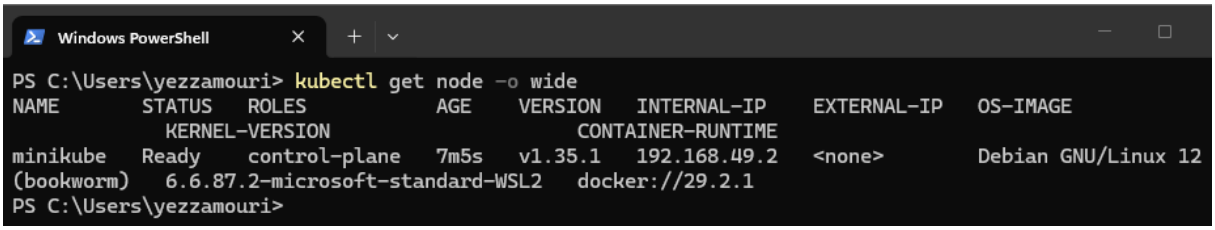
```
PS C:\Users\yezzamouri> kubectl get namespace
NAME              STATUS   AGE
default           Active   5m22s
kube-node-lease   Active   5m21s
kube-public       Active   5m22s
kube-system       Active   5m22s
PS C:\Users\yezzamouri>
```

- Les objets : singulier ou pluriel, peu importe :

```
PS C:\Users\yezzamouri> kubectl get pods
NAME     READY   STATUS    RESTARTS   AGE
monpod   1/1     Running   0          2m16s
PS C:\Users\yezzamouri> kubectl get pod
NAME     READY   STATUS    RESTARTS   AGE
monpod   1/1     Running   0          2m21s
PS C:\Users\yezzamouri>
```

```
PS C:\Users\yezzamouri> kubectl get nodes
NAME       STATUS   ROLES           AGE     VERSION
minikube   Ready    control-plane   6m33s   v1.35.1
PS C:\Users\yezzamouri> kubectl get node
NAME       STATUS   ROLES           AGE     VERSION
minikube   Ready    control-plane   6m37s   v1.35.1
PS C:\Users\yezzamouri>
```

- Champs supplémentaires :



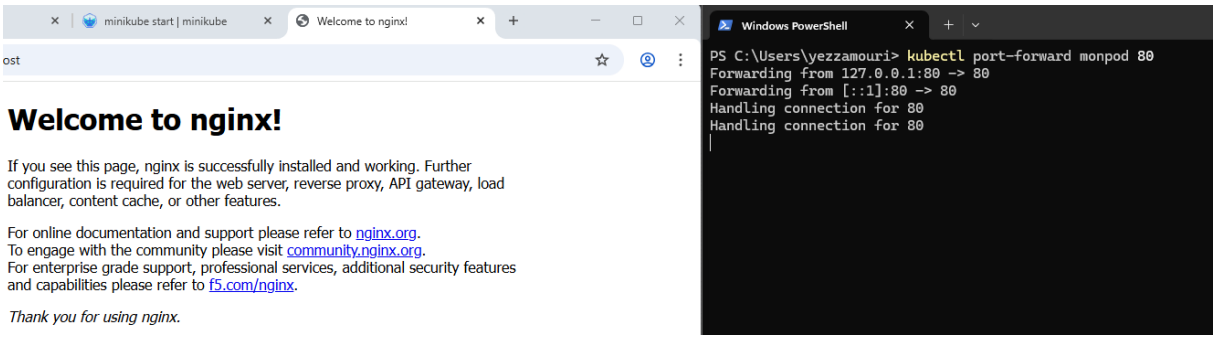
- J'accède à Minikube et j'interroge le démon containerd (commande ctr précédée de sudo afin de récupérer la liste des espaces de noms). Dans le cas où Docker est utilisé comme moteur de conteneur, l'espace de noms porte la valeur moby :

```
PS C:\Users\yezzamouri> minikube ssh
Linux minikube 6.6.87.2-microsoft-standard-WSL2 #1 SMP PREEMPT_DYNAMIC Thu Jun  5 18:30:46 UTC 2025 x8
6_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
docker@minikube:~$ sudo ctr namespace ls
NAME LABELS
moby
docker@minikube:~$ sudo ctr -n moby container ls
CONTAINER                                                           IMAGE    RUNTIME
0d6f63a5e4d73c0c1463d7976e9879e8e1afdc91379fd523e3806630dbc73038    -        io.containerd.runc.v2
176195fb05d394215496ca7ee99c874973dbeaf150679671d0ca4ff49361a3de    -        io.containerd.runc.v2
31521c5d94c31a810ab9d5a644704e6a959010ad47fbcfb6505f4c9e227406b5    -        io.containerd.runc.v2
516f9012b1d4042444a2a5ec76abee8876312b0aed96a5b1d7fb3275b4be7044    -        io.containerd.runc.v2
5ba3fdf6d486330086f1aa93a2b479bf8d03b2a385e932e8930725f59a6b7d65    -        io.containerd.runc.v2
627abc7855acc4a367328a0c1ffb12b7174fe912a3d8f9ca1acc08444d632478    -        io.containerd.runc.v2
7a3644a0be316123002a6e5d71abbe7e8c4baed010f5a3a693e2334441a6d7fe    -        io.containerd.runc.v2
83937169140b24b22b819dd06d0bf9ae1800969cc360558bedb8918bfe078606    -        io.containerd.runc.v2
979fa13a2d5e1c58edf8f5b9517b6cc41a1676b5f90412e83a2cb72719c10441    -        io.containerd.runc.v2
a2c65984e4dad7356f1be1815a6099a6286a96b0e31e70cd21a73d9e598e30e8    -        io.containerd.runc.v2
ae9ccc5c35bf77034e82a38c91dccc9df3c9d28b4590e5009026b8e0bf6f366d    -        io.containerd.runc.v2
c1359af387d80e836b7d5135d855c78b908da6199e0bd29714626e42b27ef97c    -        io.containerd.runc.v2
cb3124843ea970c1026d08032efcf7cc61c2e28d04bd92346f9047f25229297a    -        io.containerd.runc.v2
d93fdbf6bc53f0249c08cd683e72217170ae292b835bb20393154c3406f91493    -        io.containerd.runc.v2
f07ab67dc7c9544f20d652e8112fe0fb7083631d221190aa9aed099a9c06c9e8    -        io.containerd.runc.v2
f322cad2a2eb284a9e9043294ba1cacd89b6ab662053ae27784aedd7b4947895    -        io.containerd.runc.v2
docker@minikube:~$ exit
```

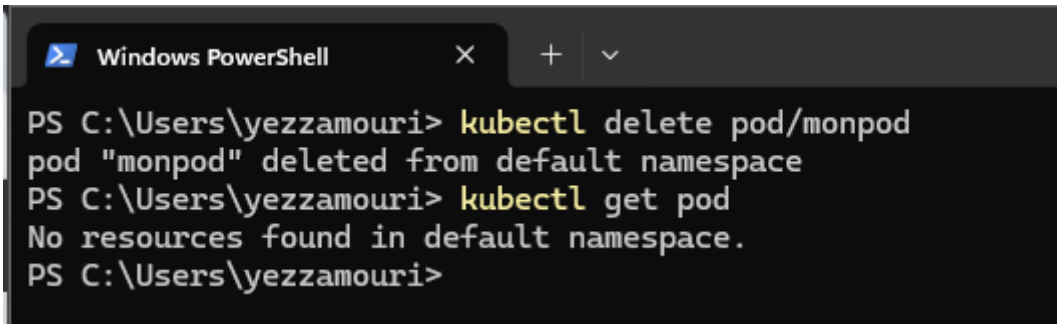
- Description d'un objet (en l'occurrence un pod) :

```
Windows PowerShell
PS C:\Users\yezzamouri> kubectl describe pod/monpod
Name:             monpod
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Wed, 29 Apr 2026 15:38:32 +0200
Labels:           run=monpod
Annotations:      <none>
Status:           Running
IP:               10.244.0.3
IPs:
  IP:  10.244.0.3
Containers:
  monpod:
    Container ID:   docker://516f9012b1d4042444a2a5ec76abee8876312b0aed96a5b1d7fb3275b4be7044
    Image:          nginx:latest
    Image ID:       docker-pullable://nginx@sha256:6e23479198b998e5e25921dff8455837c7636a67111a04a635c
f1bb363d199dc
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Wed, 29 Apr 2026 15:38:41 +0200
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-2w2g6 (ro)
Conditions:
  Type                        Status
  PodReadyToStartContainers   True
  Initialized                 True
  Ready                       True
  ContainersReady             True
  PodScheduled                True
Volumes:
  kube-api-access-2w2g6:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    Optional:                false
    DownwardAPI:             true
```

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

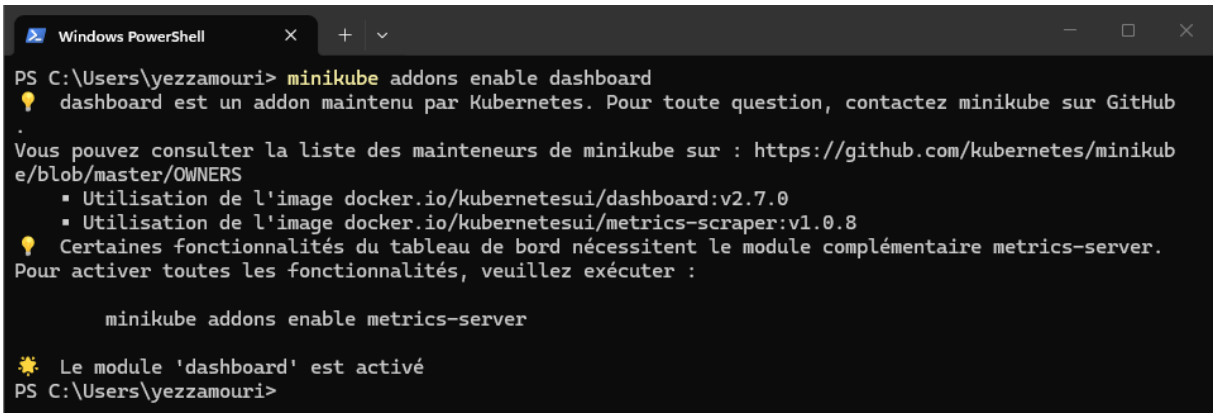


- Je détruis le pod nginx :

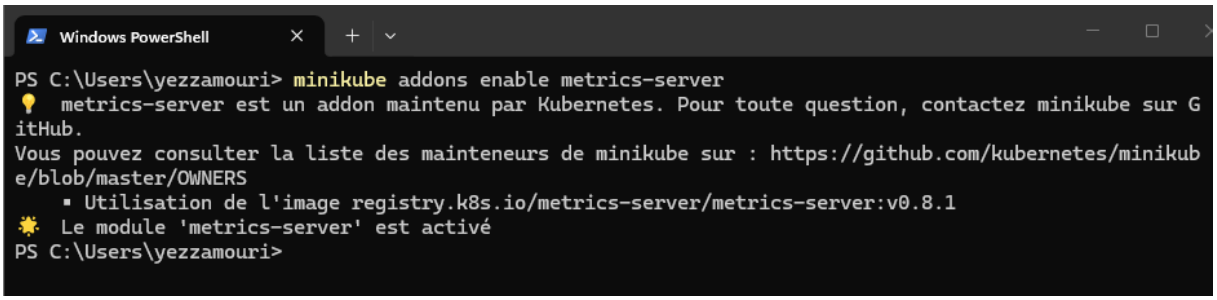


3 – Le tableau de bord de Kubernetes :

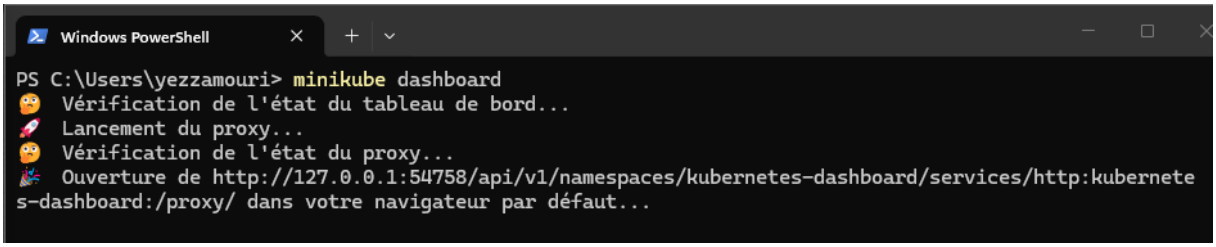
- J'active le plugin :

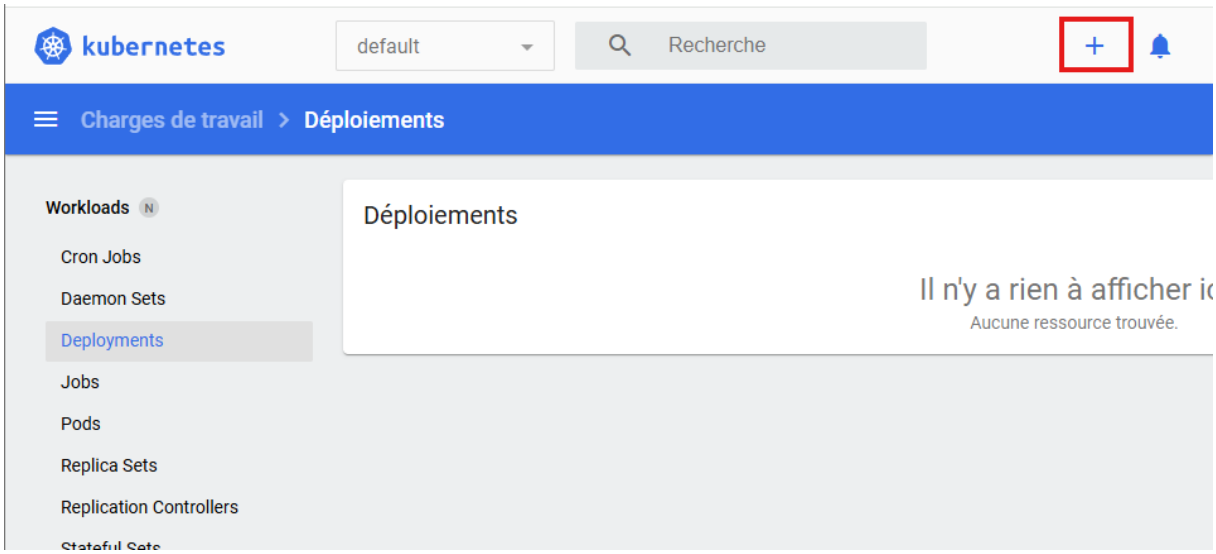


- Comme indiqué ci-dessus, j'active le serveur de métriques pour bénéficier de l'ensemble des fonctionnalités du tableau de bord :

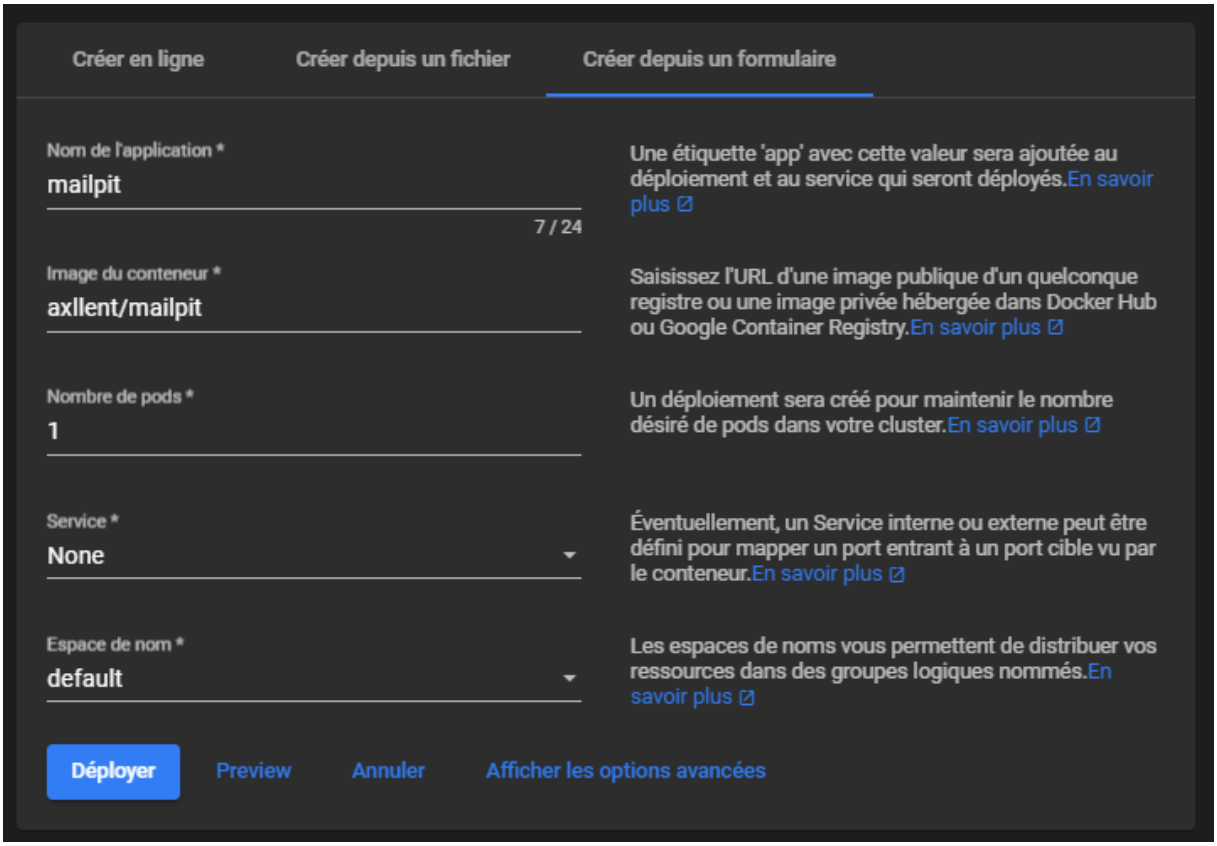


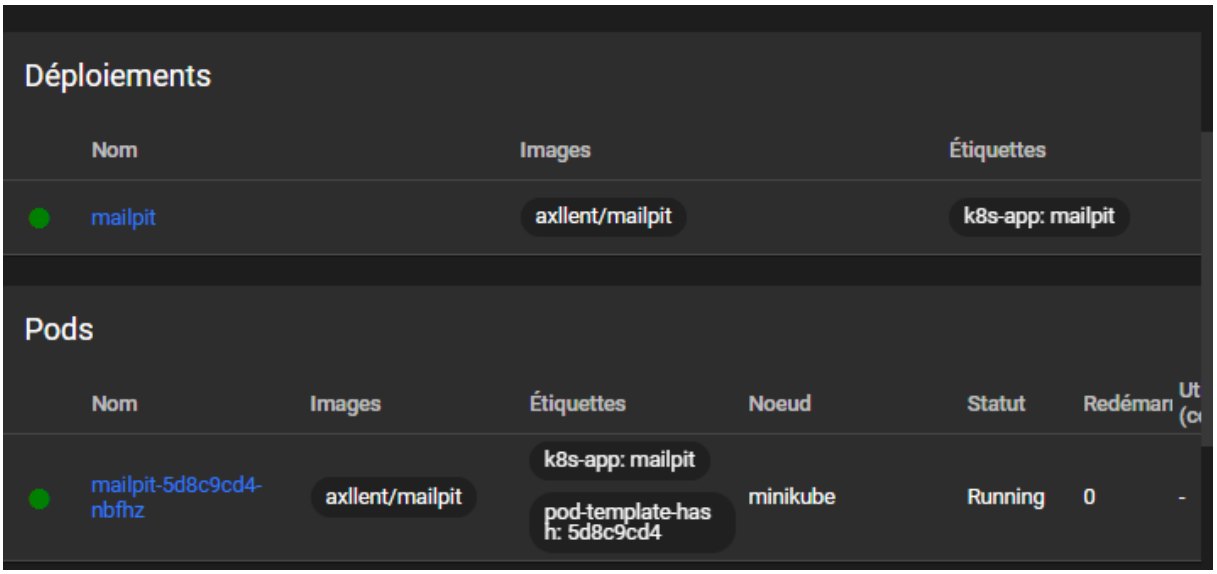
- J’accède au tableau de bord :

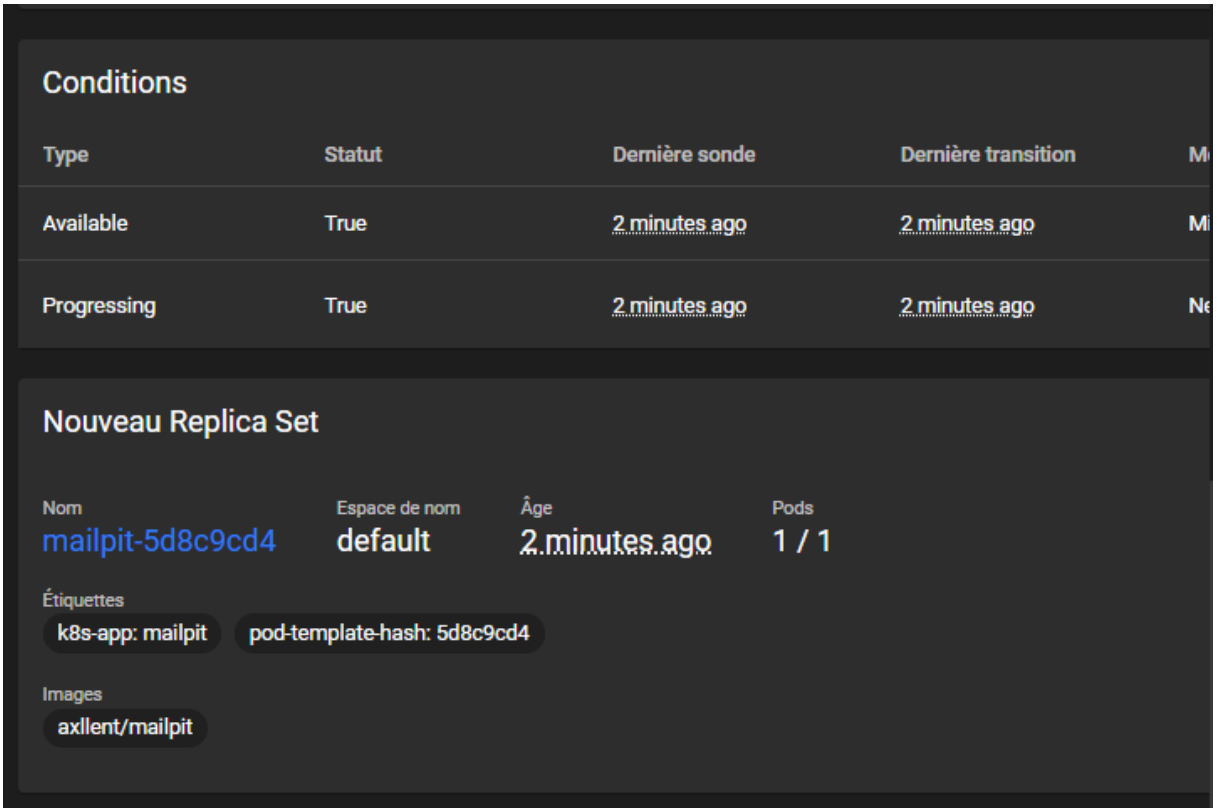


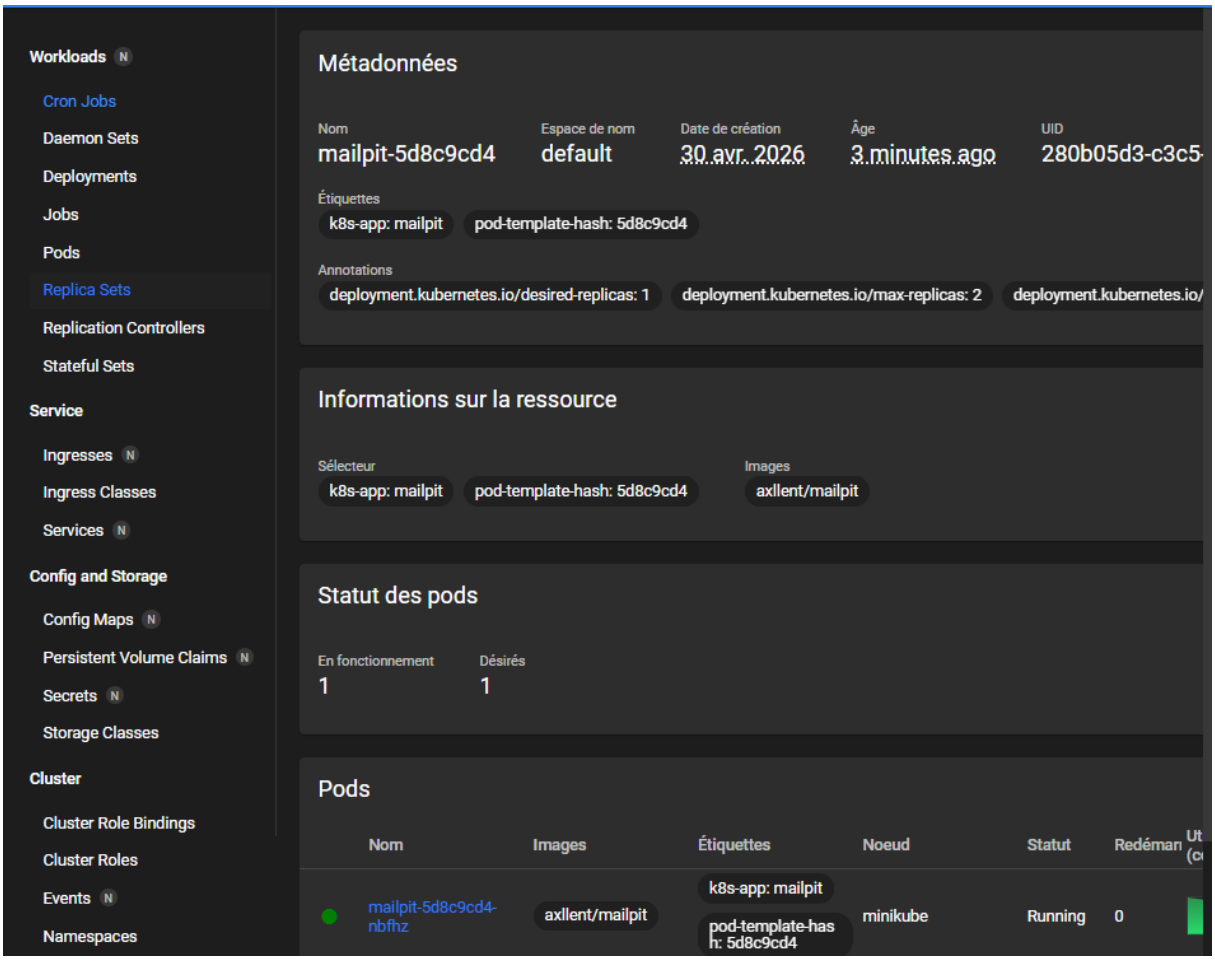


- Je crée d’un déploiement (mailpit) :

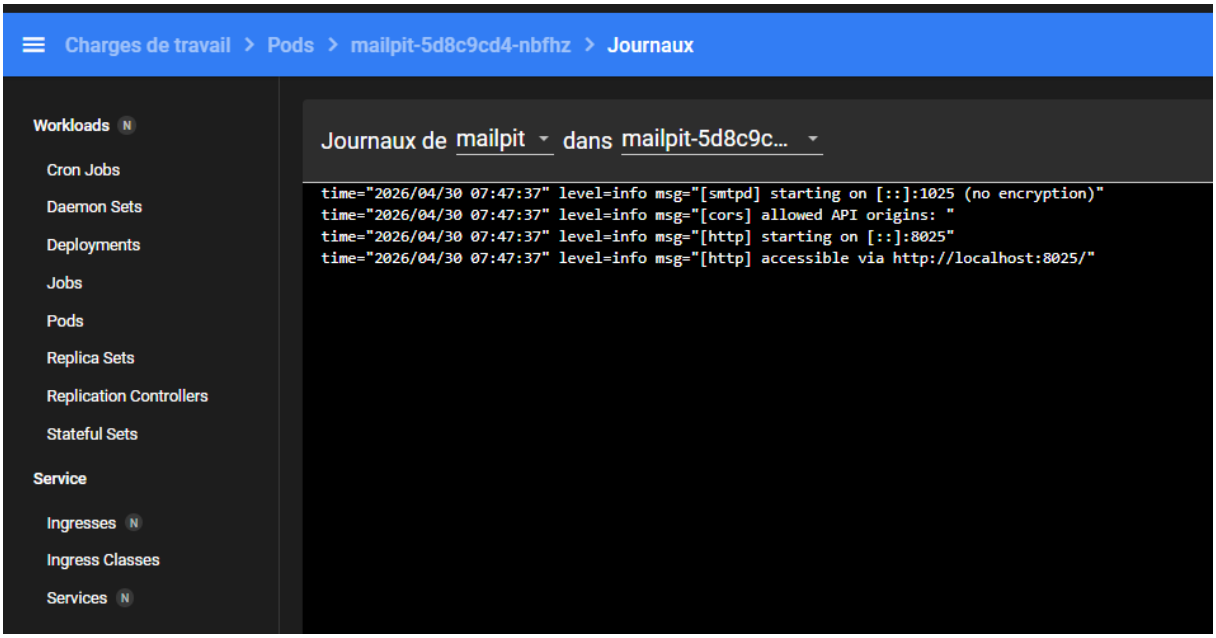



Déploiements
Nom
Images
Étiquettes
mailpit
axllent/mailpit
k8s-app: mailpit
Pods
Nom
Images
Étiquettes
Noeud
Statut
Redémarr
Ut (c
mailpit-5d8c9cd4-nbfhz
axllent/mailpit
k8s-app: mailpit
pod-template-hash: 5d8c9cd4
minikube
Running
0
-

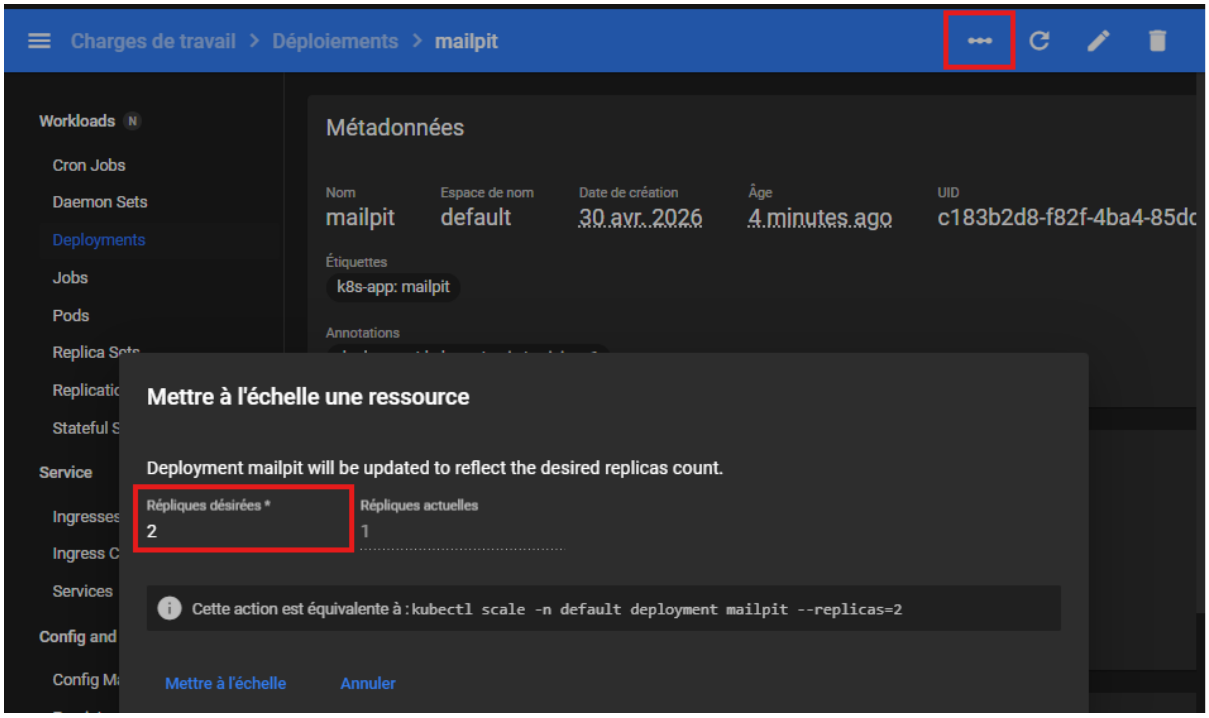

Conditions
Type
Statut
Dernière sonde
Dernière transition
Available
True
2 minutes ago
2 minutes ago
Progressing
True
2 minutes ago
2 minutes ago
Nouveau Replica Set
Nom
mailpit-5d8c9cd4
Espace de nom
default
Âge
2 minutes ago
Pods
1 / 1
Étiquettes
k8s-app: mailpit
pod-template-hash: 5d8c9cd4
Images
axllent/mailpit

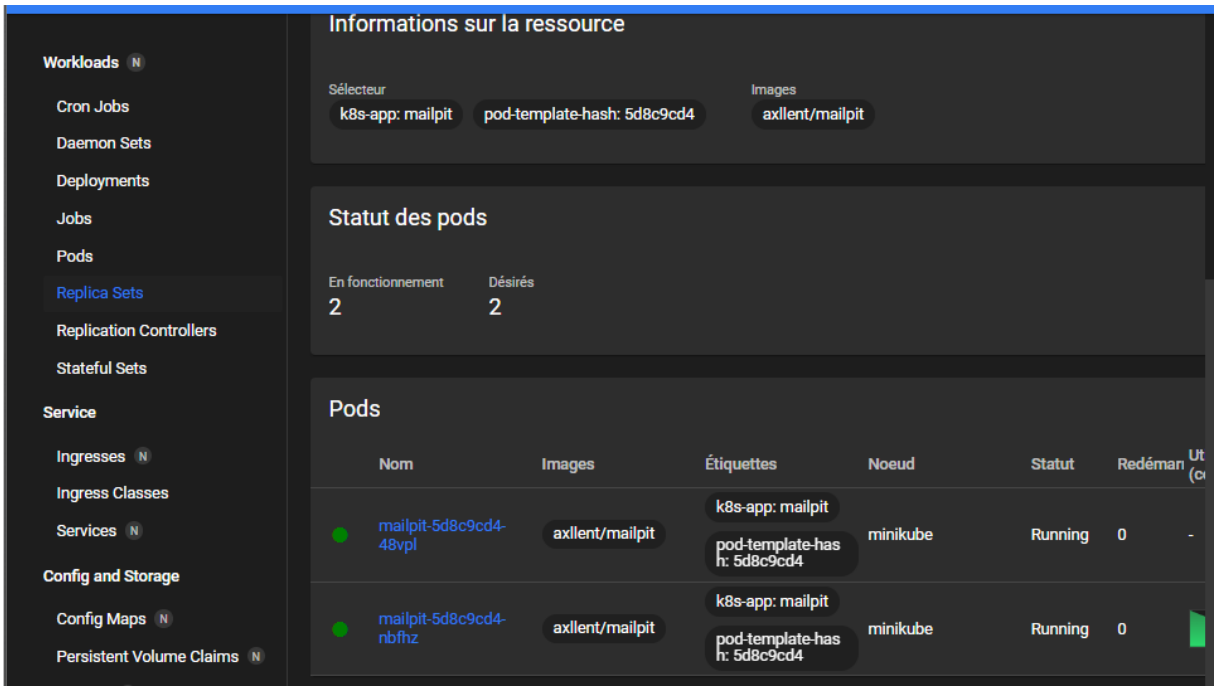


- Je consulte les journaux :

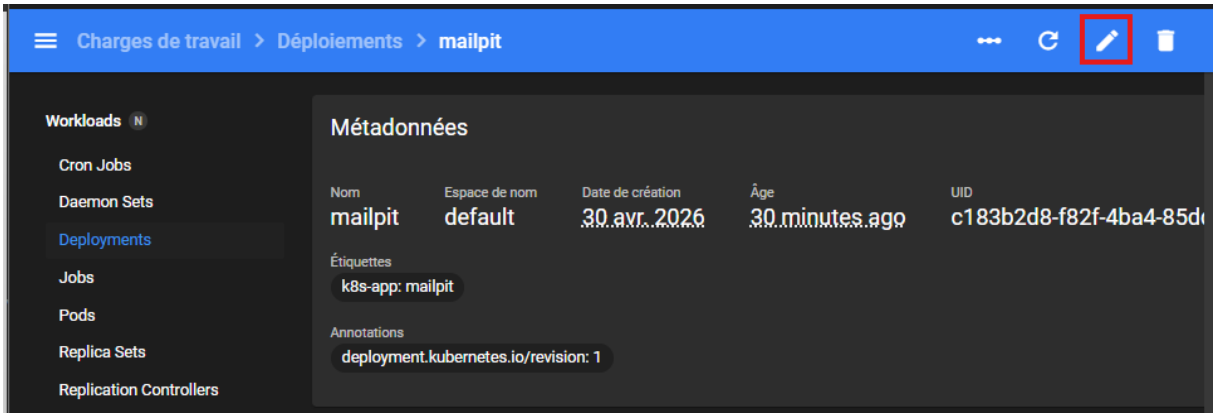


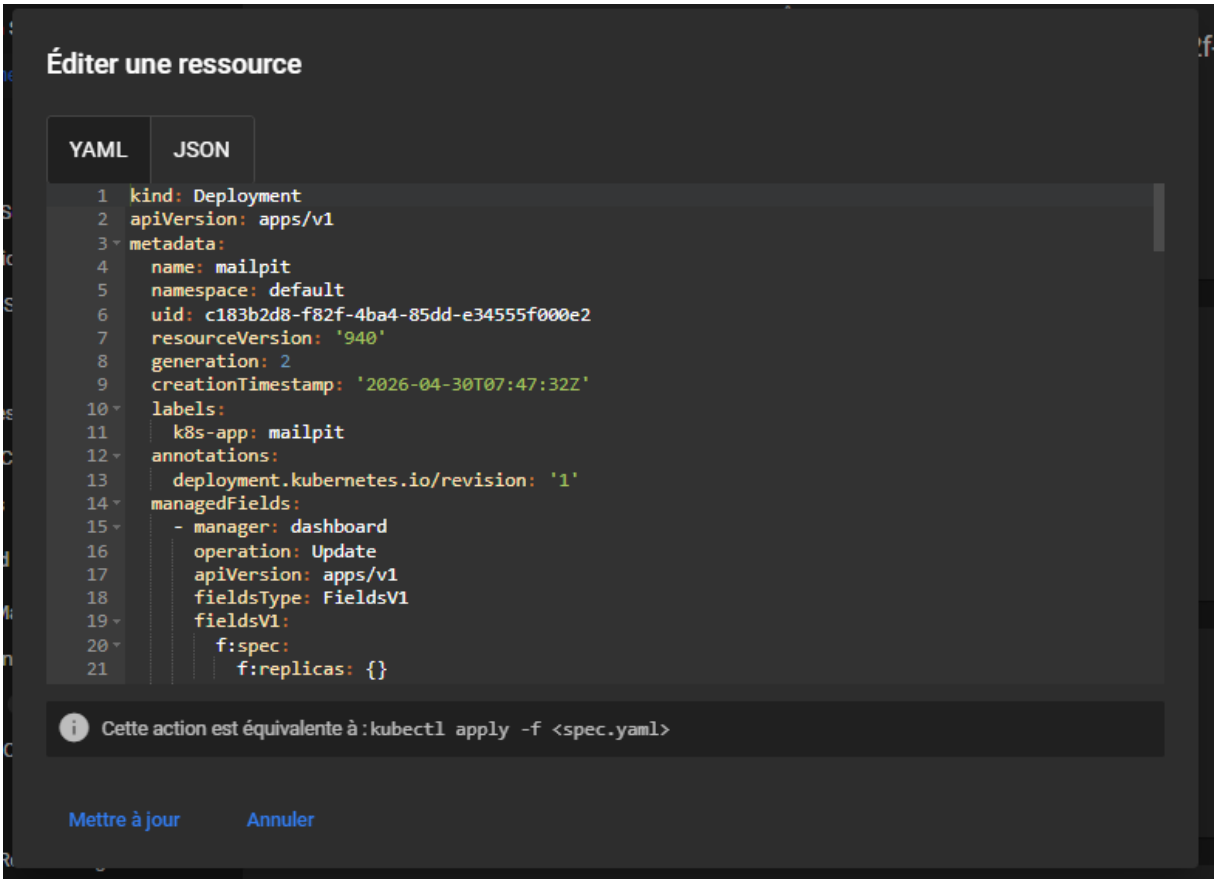
- Scalabilité :

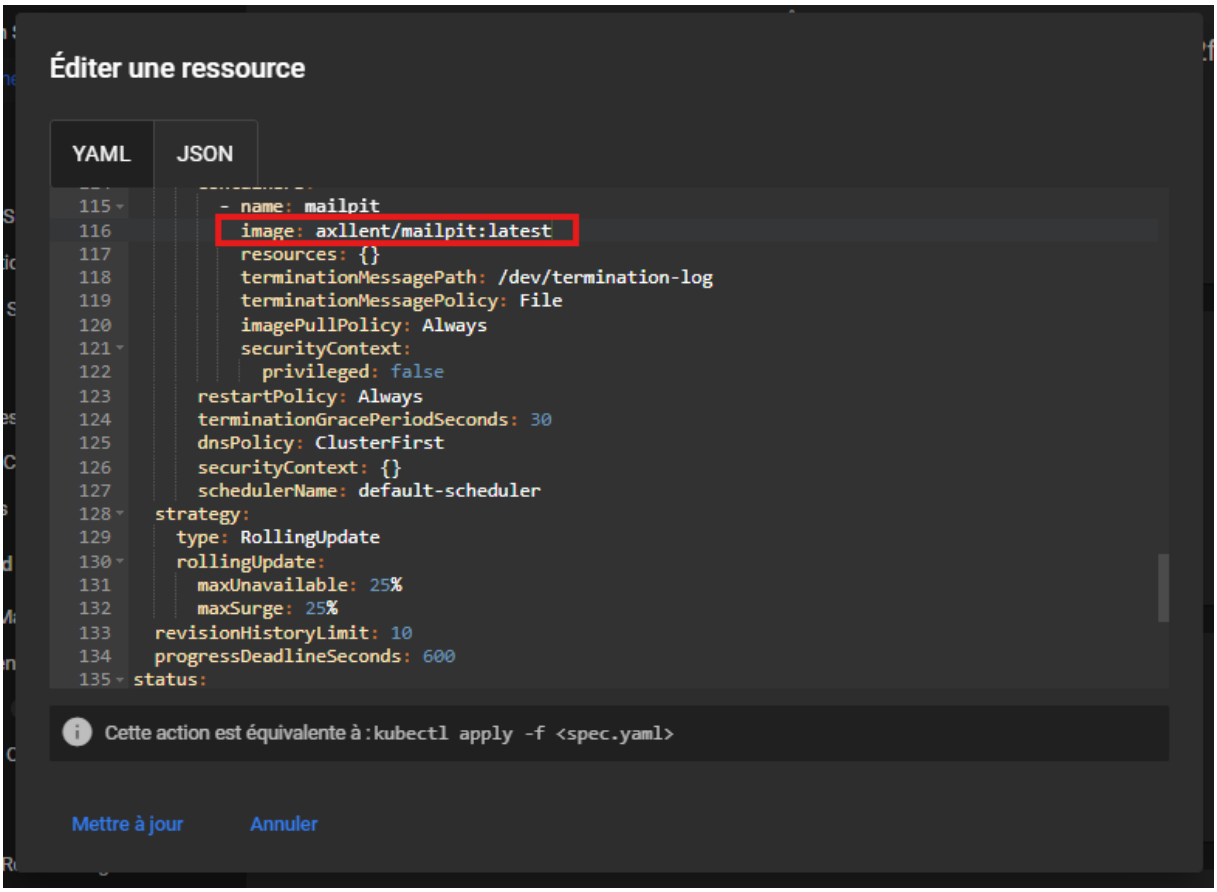




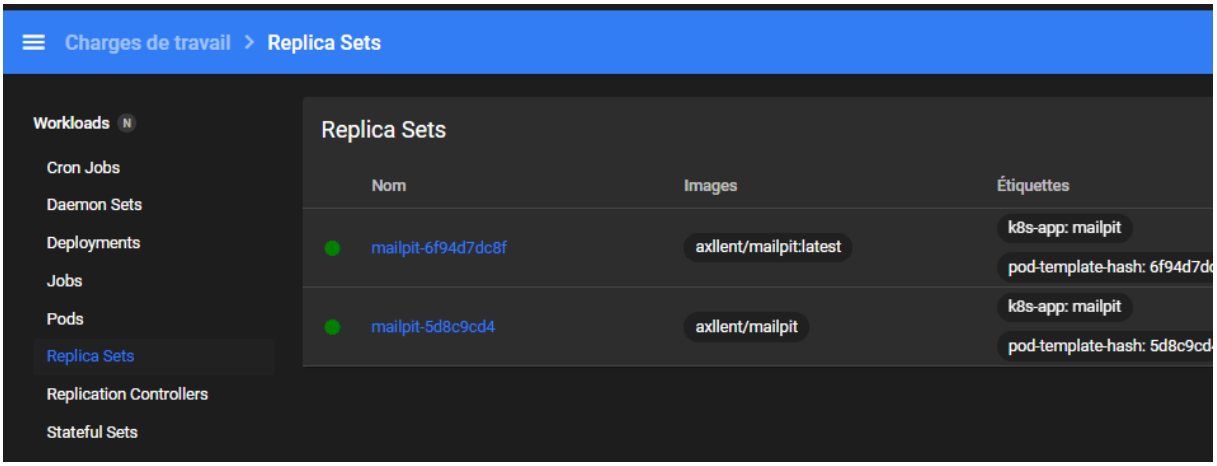
Mise à jour :

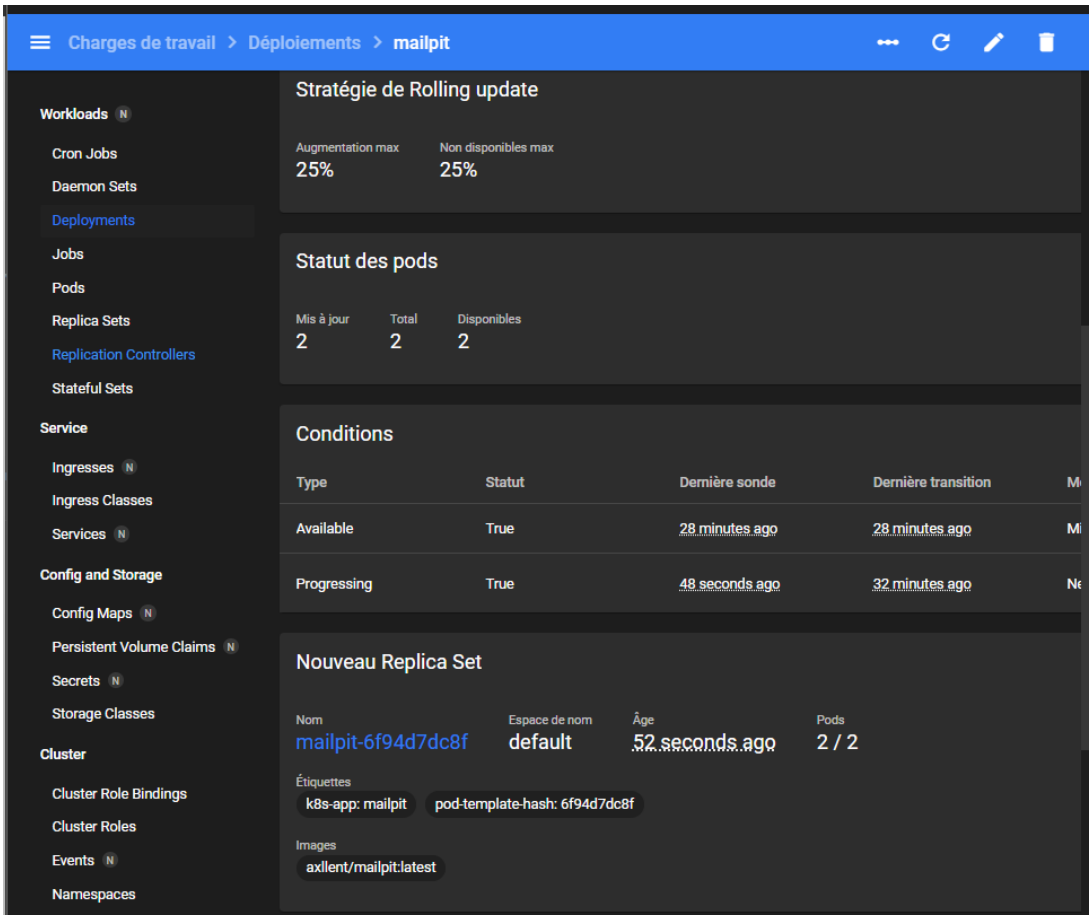

Charges de travail > Déploiements > mailpit
Workloads N
Cron Jobs
Daemon Sets
Deployments
Jobs
Pods
Replica Sets
Replication Controllers
Métadonnées
Nom
mailpit
Espace de nom
default
Date de création
30 avr. 2026
Âge
30 minutes ago
UID
c183b2d8-f82f-4ba4-85d
Étiquettes
k8s-app: mailpit
Annotations
deployment.kubernetes.io/revision: 1


Éditer une ressource
YAML
JSON
kind: Deployment
apiVersion: apps/v1
metadata:
name: mailpit
namespace: default
uid: c183b2d8-f82f-4ba4-85dd-e34555f000e2
resourceVersion: '940'
generation: 2
creationTimestamp: '2026-04-30T07:47:32Z'
labels:
k8s-app: mailpit
annotations:
deployment.kubernetes.io/revision: '1'
managedFields:
- manager: dashboard
operation: Update
apiVersion: apps/v1
fieldsType: FieldsV1
fieldsV1:
f:spec:
f:replicas: {}
Cette action est équivalente à : kubectl apply -f <spec.yaml>
Mettre à jour
Annuler



- Kubernetes va créer un nouveau ReplicaSet :





4 – Créer un déploiement à l'aide de l'outil kubectl :

- Je supprime un déploiement :

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get deployment
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mailpit   2/2     2            2           34m
PS C:\WINDOWS\system32> kubectl delete deployment mailpit
deployment.apps "mailpit" deleted from default namespace
PS C:\WINDOWS\system32>
```

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get deployment
No resources found in default namespace.
PS C:\WINDOWS\system32>
```

- Je crée un déploiement :

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl create deployment mailpit --image=axllent/mailpit
deployment.apps/mailpit created
PS C:\WINDOWS\system32>
```

- Je consulte l'état du déploiement :

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get deployment
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mailpit   1/1     1            1           31s
PS C:\WINDOWS\system32> kubectl get deployment -o wide
NAME      READY   UP-TO-DATE   AVAILABLE   AGE   CONTAINERS   IMAGES            SELECTOR
mailpit   1/1     1            1           38s   mailpit      axllent/mailpit   app=mailpit
PS C:\WINDOWS\system32>
```

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl describe deployment mailpit
Name:                   mailpit
Namespace:              default
CreationTimestamp:      Thu, 30 Apr 2026 10:23:36 +0200
Labels:                 app=mailpit
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               app=mailpit
Replicas:               1 desired | 1 updated | 1 total | 1 available | 0 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      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
NewReplicaSet:   mailpit-7b96b48c5d (1/1 replicas created)
Events:
  Type    Reason             Age   From                   Message
  ----    ------             ----  ----                   -------
  Normal  ScalingReplicaSet  95s   deployment-controller  Scaled up replica set mailpit-7b96b48c5d from 0 to 1
PS C:\WINDOWS\system32>
```

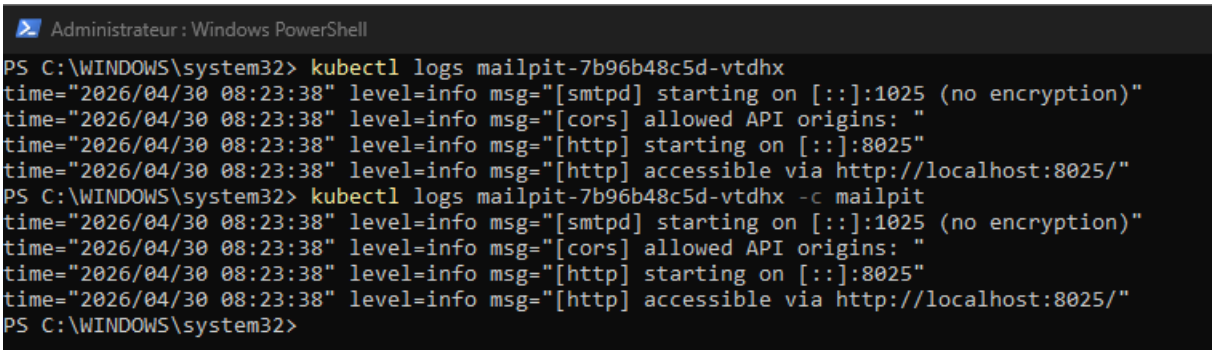
- Réplicas :

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get replicaset
NAME                 DESIRED   CURRENT   READY   AGE
mailpit-7b96b48c5d   1         1         1       2m43s
PS C:\WINDOWS\system32> 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:    1 Running / 0 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  3m39s  replicaset-controller  Created pod: mailpit-7b96b48c5d-vtdhx
PS C:\WINDOWS\system32>
```

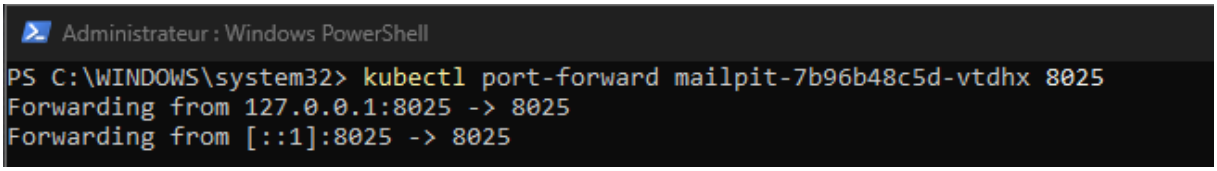
- Etat du pod :

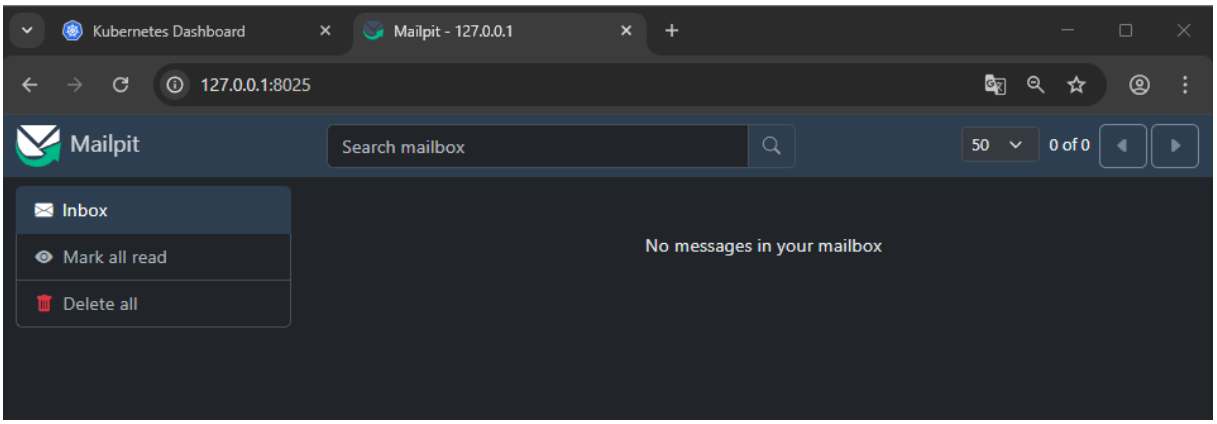
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get pods
NAME                       READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-vtdhx   1/1     Running   0          4m4s
PS C:\WINDOWS\system32> kubectl describe pods mailpit-7b96b48c5d
Name:             mailpit-7b96b48c5d-vtdhx
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.49.2
Start Time:       Thu, 30 Apr 2026 10:23:36 +0200
Labels:           app=mailpit
                  pod-template-hash=7b96b48c5d
Annotations:      <none>
Status:           Running
IP:               10.244.0.16
IPs:
  IP:           10.244.0.16
Controlled By:  ReplicaSet/mailpit-7b96b48c5d
Containers:
  mailpit:
    Container ID:   docker://05a78a719774a05cf357ce6078e067b9432986b81dc3b0d752dbf17c1d083f6e
    Image:          axllent/mailpit
    Image ID:       docker-pullable://axllent/mailpit@sha256:757f22b56c1da03570afdb3d259effe5091018008a81bbedc8158cee
7e16fdbc
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Thu, 30 Apr 2026 10:23:37 +0200
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-qpnp8 (ro)
Conditions:
  Type                        Status
  PodReadyToStartContainers   True
  Initialized                 True
  Ready                       True
  ContainersReady             True
  PodScheduled                True
Volumes:
  kube-api-access-qpnp8:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    Optional:                false
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  4m54s  default-scheduler  Successfully assigned default/mailpit-7b96b48c5d-vtdhx to minikube
  Normal  Pulling    4m54s  kubelet            Pulling image "axllent/mailpit"
  Normal  Pulled     4m53s  kubelet            Successfully pulled image "axllent/mailpit" in 929ms (929ms including
waiting). Image size: 36229179 bytes.
  Normal  Created    4m53s  kubelet            Container created
  Normal  Started    4m52s  kubelet            Container started
```

- J’accède aux logs du pod et des conteneurs :

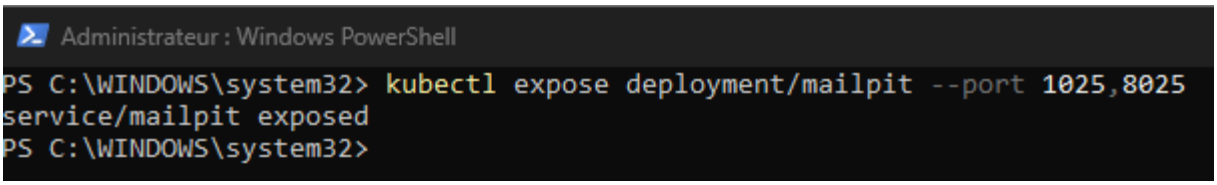


- J’accède à l’application Mailpit :





- Je crée une entrée DNS stable dans Kubernetes 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 :



- 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 PowerShell
PS C:\WINDOWS\system32> kubectl exec -it mailpit-7b96b48c5d-vtdhx -- sh
/ # getent hosts mailpit
10.110.41.250     mailpit.default.svc.cluster.local  mailpit.default.svc.cluster.local mailpit
/ #
```

- Je lance un pod de test :

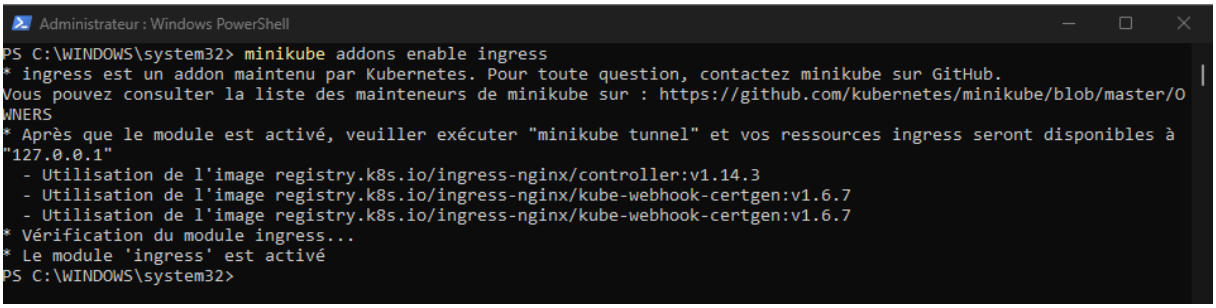
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl run -it --rm pod-test --image=alpine sh
All commands and output from this session will be recorded in container logs, including credentials and sensitive inf
ormation passed through the command prompt.
If you don't see a command 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: 10.110.41.250

/ # 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:\WINDOWS\system32>
```

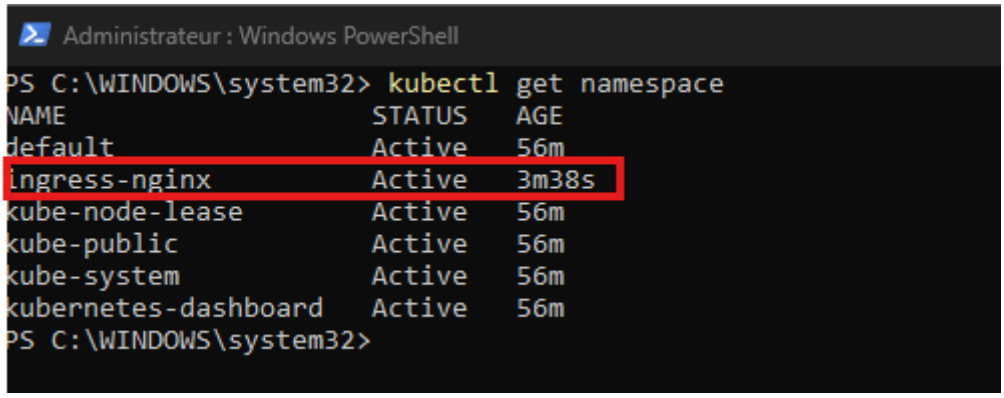
- Résilience et scalabilité (j’augmente le niveau de résilience d’une application et j’augmente la capacité de trafic d’une application pour répondre à des contraintes de charge) :

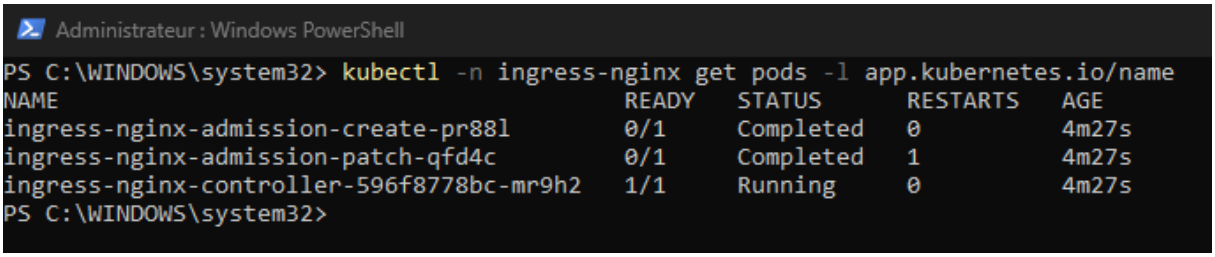
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl scale deployment mailpit --replicas=2
deployment.apps/mailpit scaled
PS C:\WINDOWS\system32>
```

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get deployment mailpit
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mailpit   2/2     2            2           12m
PS C:\WINDOWS\system32> kubectl get pods -l app=mailpit
NAME                       READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-m5pnb   1/1     Running   0          53s
mailpit-7b96b48c5d-vtdhx   1/1     Running   0          13m
PS C:\WINDOWS\system32>
```

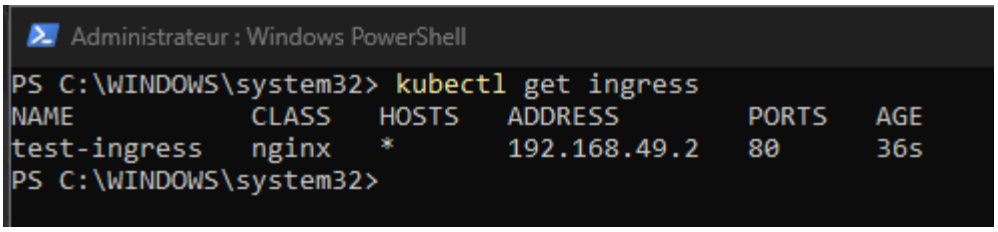
- J’active le contrôleur Ingress dans Minikube :

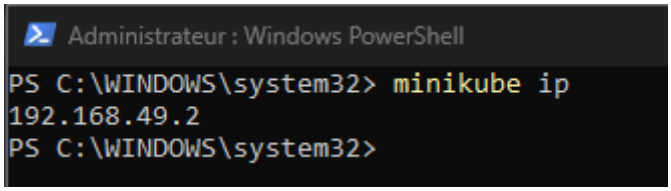


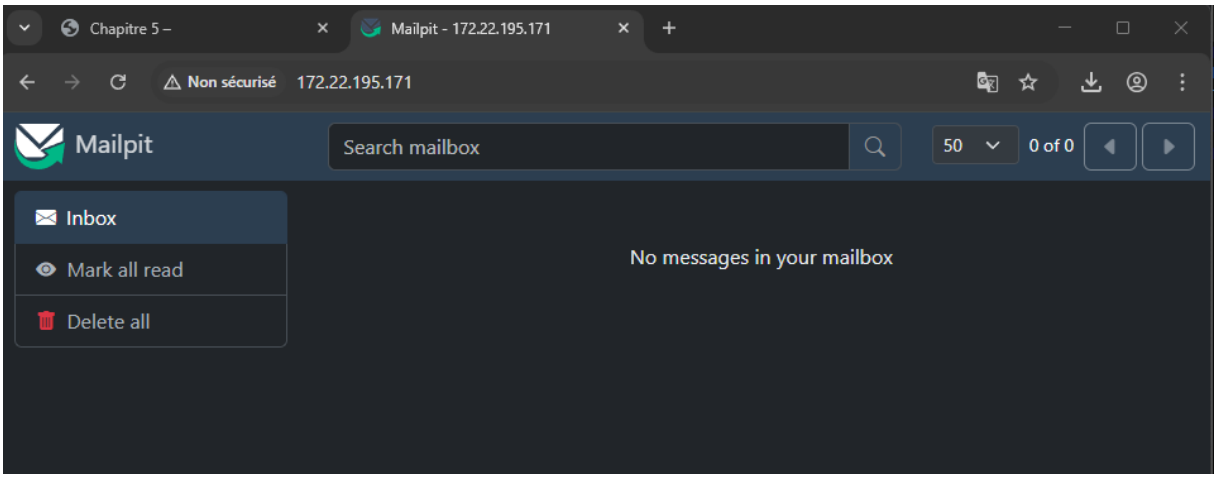




- Je déclare une règle Ingress et je prends en compte du fichier YAML :

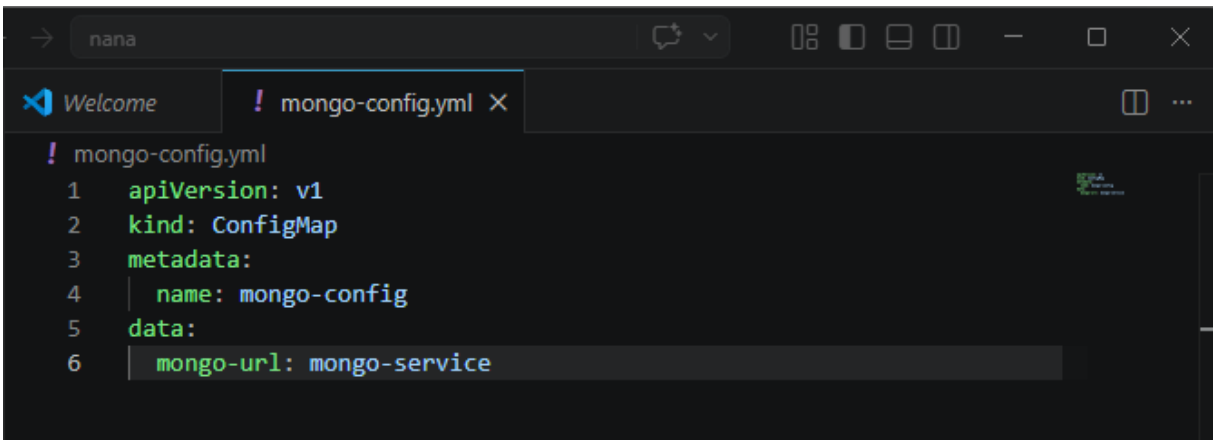




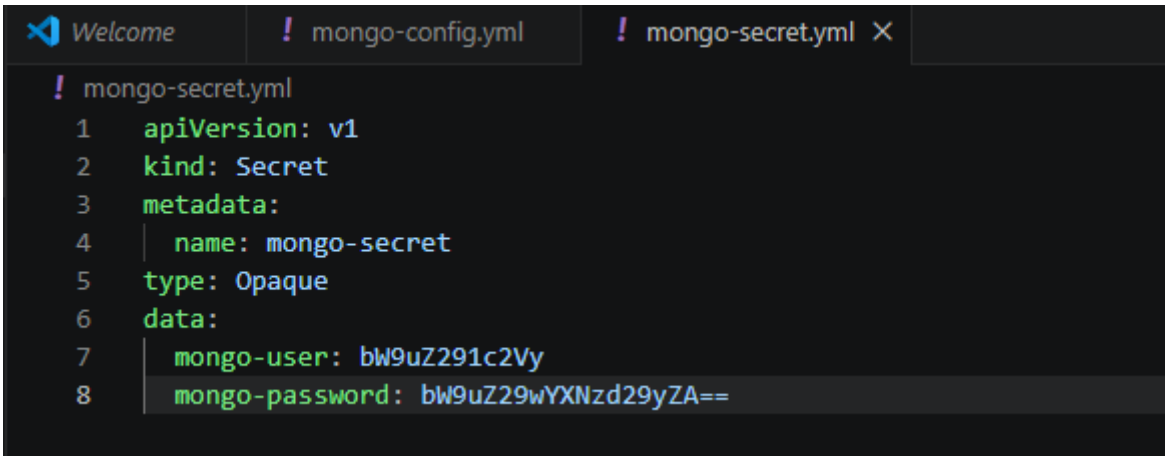


5 – Automatisation de déploiement par fichier YAML :

- Composant de type ConfigMap :

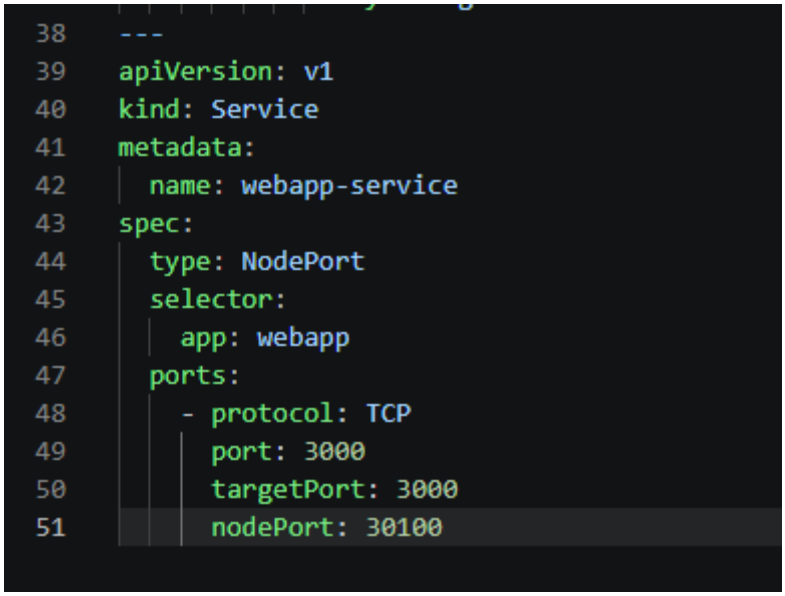


- Composant de type Secret :



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

- Je crée un service externe : pod du front accessible depuis l'extérieur du cluster Kubernetes :



- Je déploie l'application du pod front (webapp) : je crée un composant de type deployment

- Je déploie l’application mongo :

mongo-config.yml | mongo-secret.yml | mongo.yml | webapp.yml

nana > mongo.yml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: mongo-deployment
  labels:
    app: mongo
spec:
  replicas: 1
  selector:
    matchLabels:
      app: mongo
  template:
    metadata:
      labels:
        app: mongo
    spec:
      containers:
      - name: mongodb
        image: mongodb/mongodb-community-server:latest
        ports:
        - containerPort: 27017
        env:
        - name: MONGO_INITDB_ROOT_USERNAME
          valueFrom:
            secretKeyRef:
              name: mongo-secret
              key: mongo-user
        - name: MONGO_INITDB_ROOT_PASSWORD
          valueFrom:
            secretKeyRef:
              name: mongo-secret
              key: mongo-password
```

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

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  powershell - nana

PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl apply -f mongo-config.yml
configmap/mongo-config created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl apply -f mongo-secret.yml
secret/mongo-secret created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl apply -f mongo.yml
deployment.apps/mongo-deployment created
service/mongo-service created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl apply -f webapp.yml
deployment.apps/webapp-deployment created
service/webapp-service created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

- Je liste les objets créés :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get all
NAME                                    READY   STATUS              RESTARTS   AGE
pod/mailpit-7b96b48c5d-knt78            1/1     Running             0          19m
pod/mongo-deployment-744864fdd7-lrk7w   0/1     ContainerCreating   0          38s
pod/webapp-deployment-5766fd95c7-65blw  0/1     ContainerCreating   0          25s

NAME                     TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)              AGE
service/kubernetes       ClusterIP   10.96.0.1        <none>        443/TCP              35m
service/mailpit          ClusterIP   10.108.16.119    <none>        1025/TCP,8025/TCP    18m
service/mongo-service    ClusterIP   10.111.78.120    <none>        27017/TCP            38s
service/webapp-service   NodePort    10.109.220.122   <none>        3000:30100/TCP       25s

NAME                                READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/mailpit             1/1     1            1           19m
deployment.apps/mongo-deployment    0/1     1            0           38s
deployment.apps/webapp-deployment   0/1     1            0           25s

NAME                                          DESIRED   CURRENT   READY   AGE
replicaset.apps/mailpit-7b96b48c5d            1         1         1       19m
replicaset.apps/mongo-deployment-744864fdd7   1         1         0       38s
replicaset.apps/webapp-deployment-5766fd95c7  1         1         0       25s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

- Je liste les autres objets (configMap et Secret) :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get configmap
NAME               DATA   AGE
kube-root-ca.crt   1      36m
mongo-config       1      92s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get secret
NAME           TYPE     DATA   AGE
mongo-secret   Opaque   2      89s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

- Je décris le service webapp-service :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> 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:                       10.109.220.122
IPs:                      10.109.220.122
Port:                     <unset>  3000/TCP
TargetPort:               3000/TCP
NodePort:                 <unset>  30100/TCP
Endpoints:                10.244.0.11:3000
Session Affinity:         None
External Traffic Policy:  Cluster
Internal Traffic Policy:  Cluster
Events:                   <none>
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

- Je décris le pod associé :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl describe pod webapp-deployment-5766fd95c7
-65blw
Name:             webapp-deployment-5766fd95c7-65blw
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/172.22.195.171
Start Time:       Thu, 30 Apr 2026 11:48:12 +0200
Labels:           app=webapp
                  pod-template-hash=5766fd95c7
Annotations:      <none>
Status:           Running
IP:               10.244.0.11
IPs:
  IP:           10.244.0.11
Controlled By:  ReplicaSet/webapp-deployment-5766fd95c7
Containers:
  webapp:
    Container ID:   docker://6c0c9af037df3b48dcbd75fd5145667ce825e39ea31c0e83b2da394e4d4f9a
5c
    Image:          nanajanashia/k8s-demo-app:v1.0
    Image ID:       docker-pullable://nanajanashia/k8s-demo-app@sha256:6f554135da39ac00a1c2
f43e44c2b0b54ca13d3d8044da969361e7781adb7f95
    Port:           3000/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Thu, 30 Apr 2026 11:48:48 +0200
    Ready:          True
    Restart Count:  0
    Environment:
      USER_NAME:  <set to the key 'mongo-user' in secret 'mongo-secret'>      Optional: fal
se
      USER_PWD:   <set to the key 'mongo-password' in secret 'mongo-secret'>  Optional: fal
se
      DB_URL:     <set to the key 'mongo-url' of config map 'mongo-config'>   Optional: fal
se
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-scjrl (ro)
Conditions:
  Type                        Status
  PodReadyToStartContainers   True
  Initialized                 True
  Ready                       True
  ContainersReady             True
  PodScheduled                True
```

- Je consulte les logs de ce pod :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get pod
NAME                                 READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-knt78             1/1     Running   0          24m
mongo-deployment-744864fdd7-lrk7w    1/1     Running   0          5m33s
webapp-deployment-5766fd95c7-65blw   1/1     Running   0          5m20s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl logs webapp-deployment-5766fd95c7-65blw
app listening on port 3000!
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl logs webapp-deployment-5766fd95c7-65blw -
f
app listening on port 3000!
```

- Je liste les services :

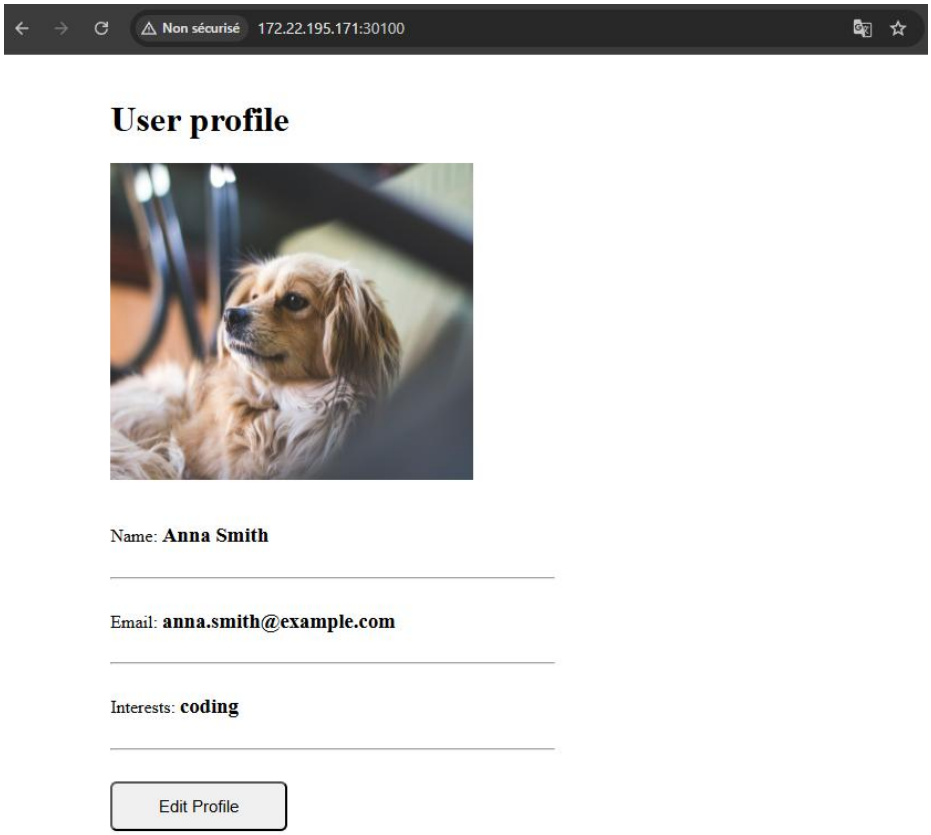
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get service
NAME             TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)             AGE
kubernetes       ClusterIP   10.96.0.1        <none>        443/TCP             41m
mailpit          ClusterIP   10.108.16.119    <none>        1025/TCP,8025/TCP   24m
mongo-service    ClusterIP   10.111.78.120    <none>        27017/TCP           6m24s
webapp-service   NodePort    10.109.220.122   <none>        3000:30100/TCP      6m11s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> minikube ip
172.22.195.171
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

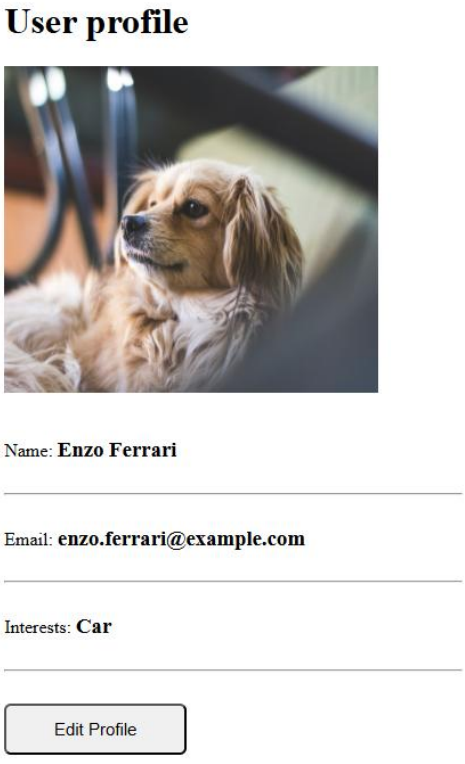
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get node
NAME       STATUS   ROLES           AGE   VERSION
minikube   Ready    control-plane   42m   v1.35.1
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get node -o wide
NAME       STATUS   ROLES           AGE   VERSION   INTERNAL-IP      EXTERNAL-IP   OS-IMAGE
           KERNEL-VERSION   CONTAINER-RUNTIME
minikube   Ready    control-plane   43m   v1.35.1   172.22.195.171   <none>        Buildroo
t 2025.02   6.6.95           docker://28.5.2
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get svc -o wide
NAME             TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)             AGE     SEL
ECTOR
kubernetes       ClusterIP   10.96.0.1        <none>        443/TCP             43m     <no
ne>
mailpit          ClusterIP   10.108.16.119    <none>        1025/TCP,8025/TCP   26m     app
=mailpit
mongo-service    ClusterIP   10.111.78.120    <none>        27017/TCP           8m30s   app
=mongo
webapp-service   NodePort    10.109.220.122   <none>        3000:30100/TCP      8m17s   app
=webapp
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana> kubectl get pod -o wide
NAME                                 READY   STATUS    RESTARTS   AGE     IP            NOD
E       NOMINATED NODE   READINESS GATES
mailpit-7b96b48c5d-knt78             1/1     Running   0          27m     10.244.0.9    min
ikube   <none>           <none>
mongo-deployment-744864fdd7-lrk7w    1/1     Running   0          8m40s   10.244.0.10   min
ikube   <none>           <none>
webapp-deployment-5766fd95c7-65blw   1/1     Running   0          8m27s   10.244.0.11   min
ikube   <none>           <none>
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\nana>
```

- J’arrive sur la page :



- Je modifie la page :



6 – Application :

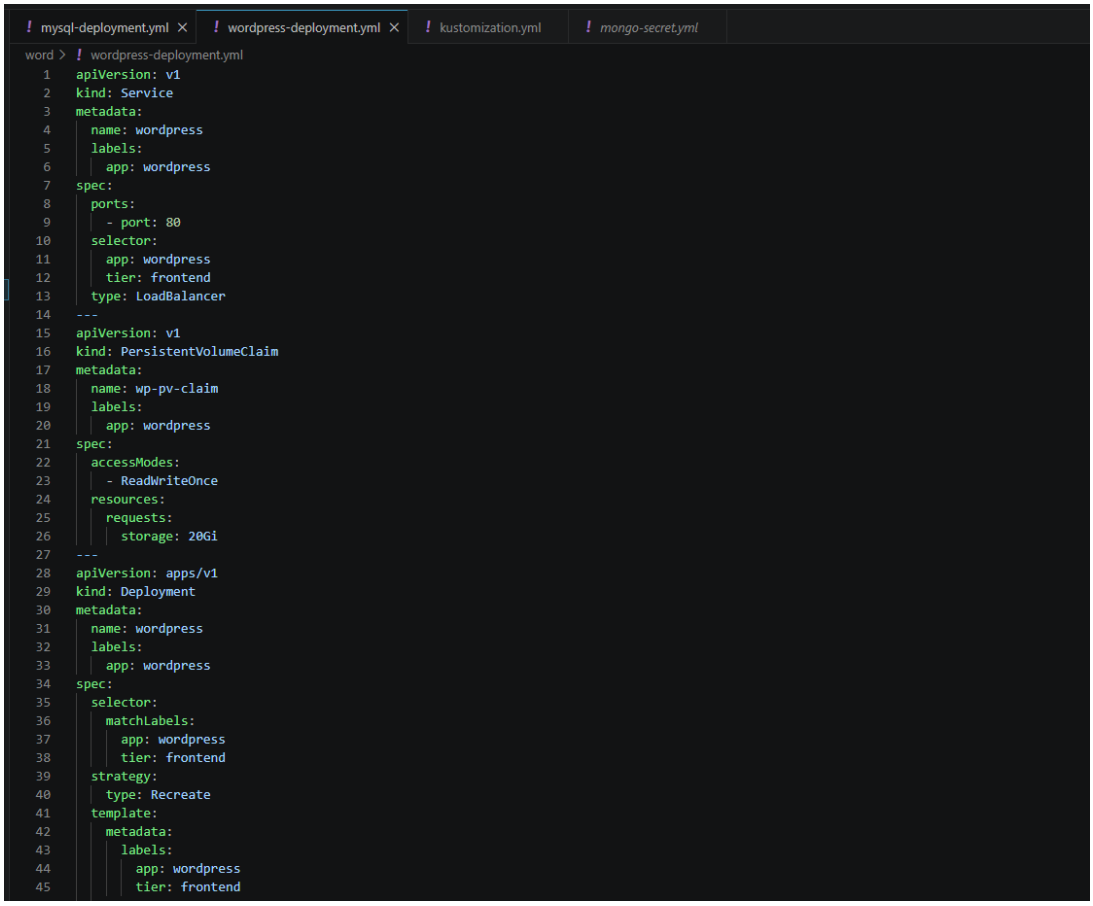
- Je crée le fichier deployment pour mysql :

mysql-deployment.yml | wordpress-deployment.yml | kustomization.yml | mongo-secret.yml

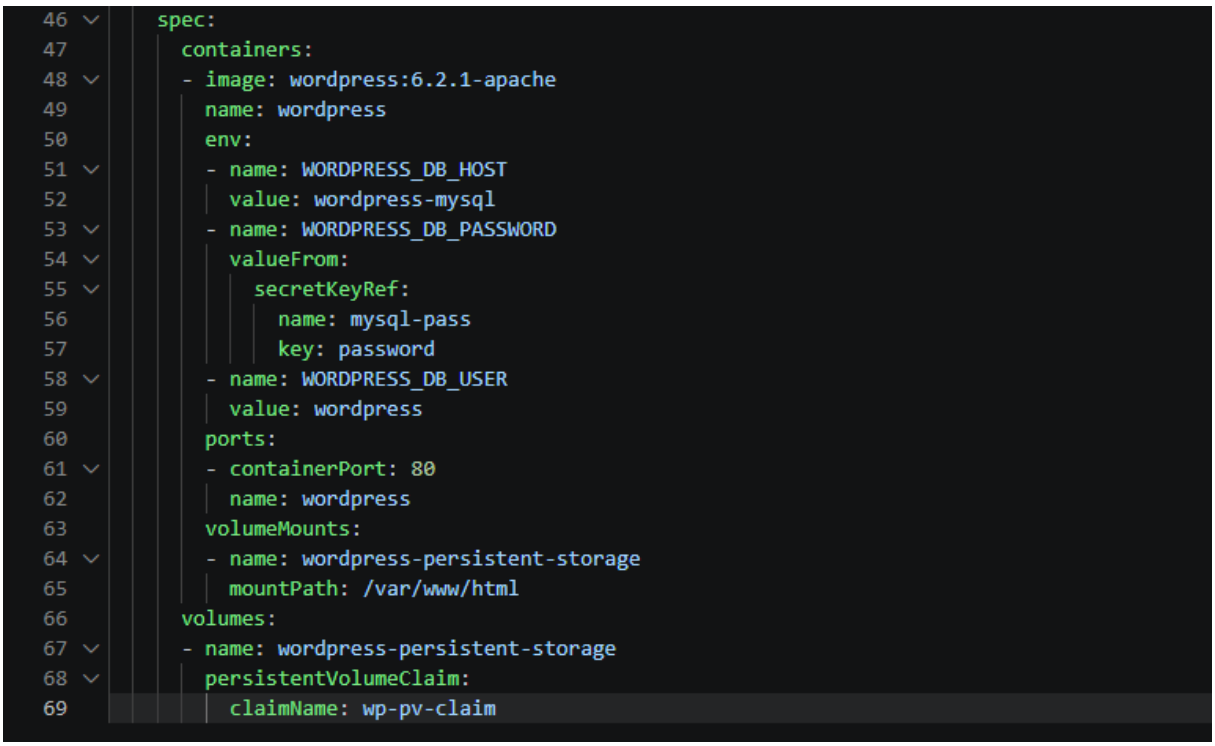
word > mysql-deployment.yml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: wordpress-mysql
  labels:
    app: wordpress
spec:
  ports:
    - port: 3306
  selector:
    app: wordpress
    tier: mysql
  clusterIP: None
---
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: mysql-pv-claim
  labels:
    app: wordpress
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 20Gi
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: wordpress-mysql
  labels:
    app: wordpress
spec:
  selector:
    matchLabels:
      app: wordpress
      tier: mysql
  strategy:
    type: Recreate
  template:
    metadata:
      labels:
        app: wordpress
        tier: mysql
    spec:
      containers:
      - image: mysql:8.0
        name: mysql
        env:
        - name: MYSQL_ROOT_PASSWORD
          valueFrom:
            secretKeyRef:
              name: mysql-pass
              key: password
        - name: MYSQL_DATABASE
          value: wordpress
        - name: MYSQL_USER
          value: wordpress
        - name: MYSQL_PASSWORD
          valueFrom:
            secretKeyRef:
              name: mysql-pass
              key: password
        ports:
        - containerPort: 3306
          name: mysql
        volumeMounts:
        - name: mysql-persistent-storage
          mountPath: /var/lib/mysql
      volumes:
      - name: mysql-persistent-storage
        persistentVolumeClaim:
          claimName: mysql-pv-claim
```

- Je crée le fichier deployment pour wordpress :



```yaml
apiVersion: v1
kind: Service
metadata:
  name: wordpress
  labels:
    app: wordpress
spec:
  ports:
    - port: 80
  selector:
    app: wordpress
    tier: frontend
  type: LoadBalancer
---
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: wp-pv-claim
  labels:
    app: wordpress
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 20Gi
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: wordpress
  labels:
    app: wordpress
spec:
  selector:
    matchLabels:
      app: wordpress
      tier: frontend
  strategy:
    type: Recreate
  template:
    metadata:
      labels:
        app: wordpress
        tier: frontend
```



```yaml
  spec:
    containers:
    - image: wordpress:6.2.1-apache
      name: wordpress
      env:
      - name: WORDPRESS_DB_HOST
        value: wordpress-mysql
      - name: WORDPRESS_DB_PASSWORD
        valueFrom:
          secretKeyRef:
            name: mysql-pass
            key: password
      - name: WORDPRESS_DB_USER
        value: wordpress
      ports:
      - containerPort: 80
        name: wordpress
      volumeMounts:
      - name: wordpress-persistent-storage
        mountPath: /var/www/html
    volumes:
    - name: wordpress-persistent-storage
      persistentVolumeClaim:
        claimName: wp-pv-claim
```

- Je crée un fichier kustomization qui les ressources pour worpress et la base mysql :

```
word > ! kustomization.yaml
1   secretGenerator:
2   - name: mysql-pass
3     literals:
4     - password=password
5
6   resources:
7     - mysql-deployment.yaml
8     - wordpress-deployment.yaml
9
10
```

- J'exécute les fichiers avec kubectl :

```
PROBLEMS  OUTPUT  TERMINAL  ...                powershell - word

PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> kubectl apply -k ./
service/wordpress created
service/wordpress-mysql created
persistentvolumeclaim/mysql-pv-claim created
persistentvolumeclaim/wp-pv-claim created
deployment.apps/wordpress created
deployment.apps/wordpress-mysql created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

- Je vérifie que le secret existe bien :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> kubectl get secrets
NAME                  TYPE     DATA   AGE
mongo-secret          Opaque   2      43m
mysql-pass-bc6ggk5g2t Opaque   1      5s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

- Je vérifie que le volume persistant est bien crée :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> kubectl get pvc
NAME            STATUS   VOLUME                                     CAPACITY   ACCESS MODE
S   STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
mysql-pv-claim  Bound    pvc-4dc8ae3f-9173-4e6b-88a5-032e73ac4fc0   20Gi       RWO
    standard       <unset>                 28s
wp-pv-claim     Bound    pvc-5bfa4ac6-15c6-40cf-8fd0-40f23e333a24   20Gi       RWO
    standard       <unset>                 28s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

- Je vérifie que les pods s'exécute bien :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> kubectl get pods
NAME                                 READY   STATUS    RESTARTS   AGE
mailpit-7b96b48c5d-knt78             1/1     Running   0          62m
mongo-deployment-744864fdd7-lrk7w    1/1     Running   0          44m
webapp-deployment-5766fd95c7-65blw   1/1     Running   0          44m
wordpress-7c77d8d74b-4mg4j           1/1     Running   0          44s
wordpress-mysql-544586bd5f-dr59d     1/1     Running   0          44s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

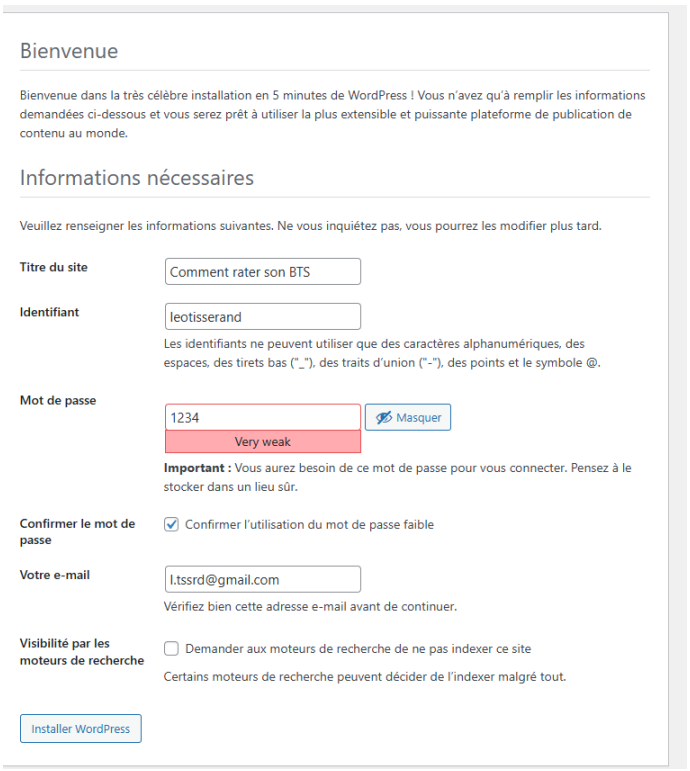
- Je vérifie que le service wordpress tourne :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> kubectl get services wordpress
NAME        TYPE           CLUSTER-IP      EXTERNAL-IP   PORT(S)        AGE
wordpress   LoadBalancer   10.103.21.229   <pending>     80:31061/TCP   64s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

- Je récupère l'url pour wordpress :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word> minikube service wordpress --url
http://172.22.195.171:31061
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\word>
```

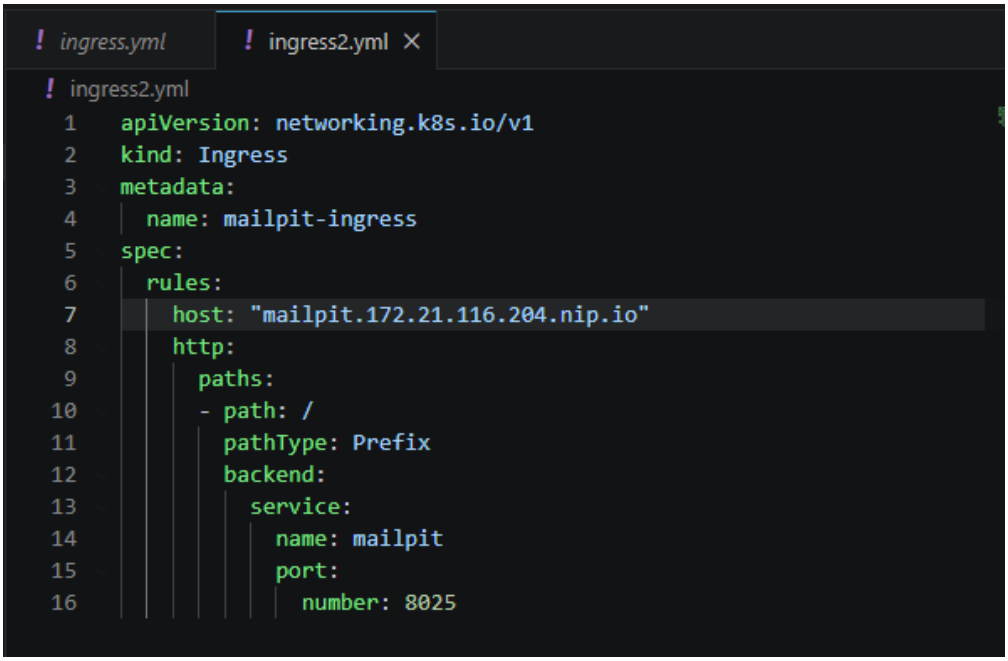
- J'accède à wordpress :



- Je suis bien sur l'interface de configuration Wordpress :

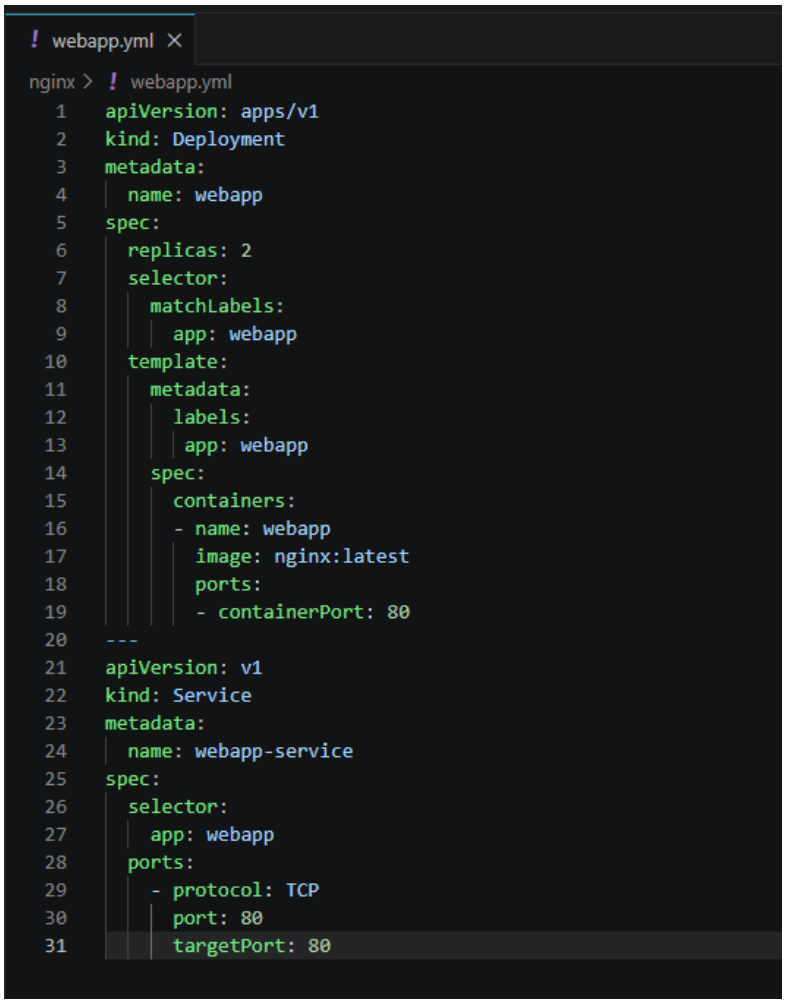
7 – Suite Ingress (Mailpit) : hôtes virtuels et nom de domaine nip.io :

- Je créeun hôte virtuel pour Mailpit : je modifie le contenu du fichier ingress.yaml afin de pointer la règle Ingress sur l'entrée DNS figurant ci-dessus :



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

- Je crée un objet Deployment et un objet Service :

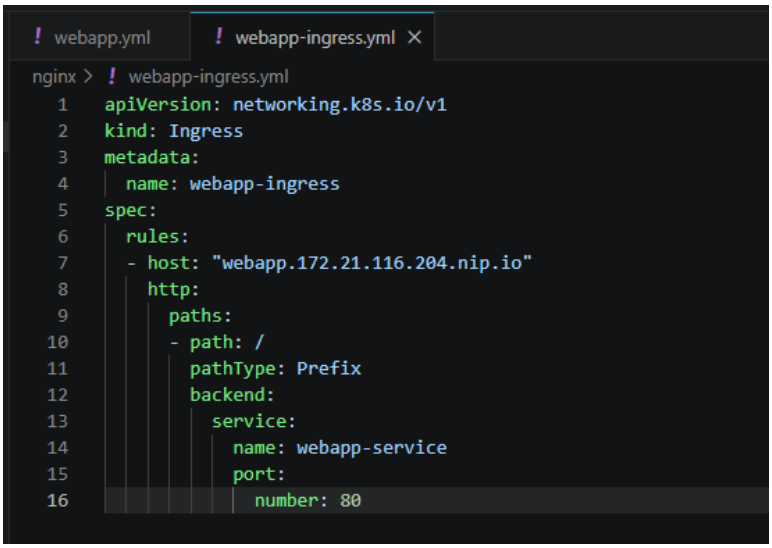


webapp.yml

nginx > webapp.yml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webapp
spec:
  replicas: 2
  selector:
    matchLabels:
      app: webapp
  template:
    metadata:
      labels:
       app: webapp
    spec:
      containers:
      - name: webapp
        image: nginx:latest
        ports:
        - containerPort: 80
---
apiVersion: v1
kind: Service
metadata:
  name: webapp-service
spec:
  selector:
    app: webapp
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
```

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

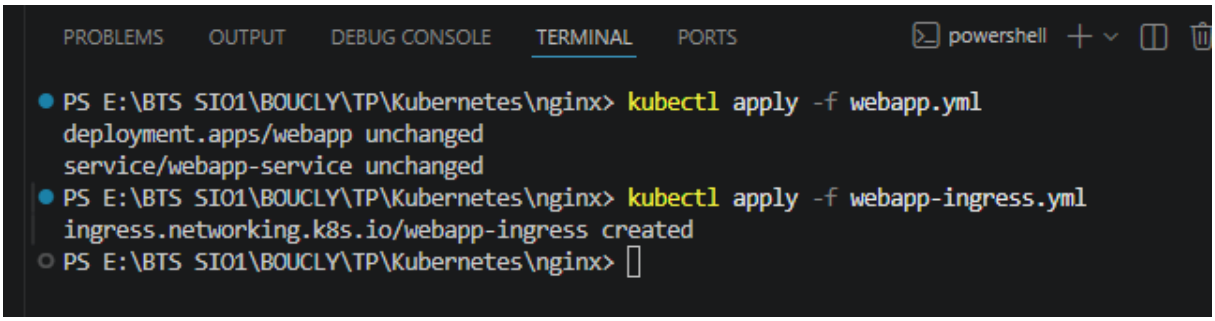


webapp.yml | webapp-ingress.yml

nginx > webapp-ingress.yml

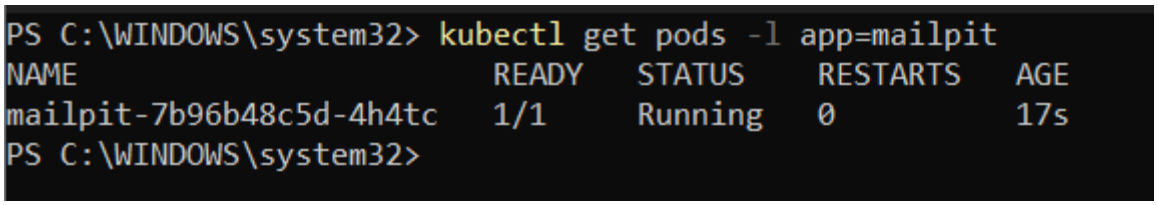
```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: webapp-ingress
spec:
  rules:
  - host: "webapp.172.21.116.204.nip.io"
    http:
      paths:
      - path: /
        pathType: Prefix
        backend:
          service:
            name: webapp-service
            port:
              number: 80
```

- Je prend en compte de 2 fichiers YAML et test :

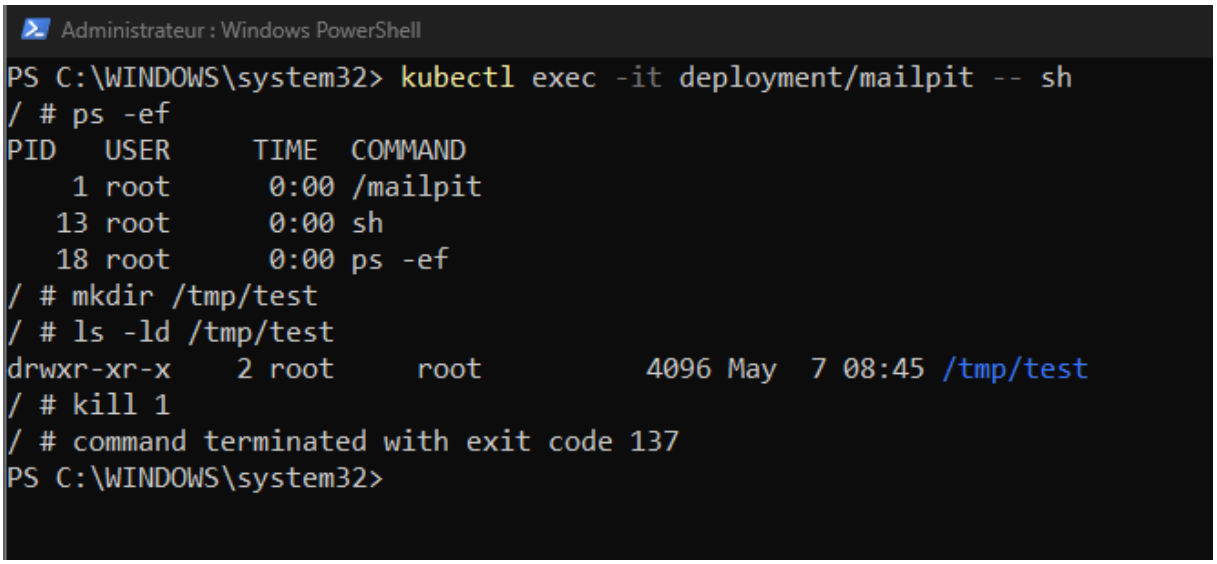


9 – Cycle de vie d'un conteneur dans Kubernetes :

- Je consulte l'état des pods de l'application portant le labell app=mailpit :



- Je me connecte au pod (j'indique le nom du pod ou le nom du déploiement). Une fois dans le contexte du conteneur de Mailpit, je liste les processus, je crée un répertoire, je liste le répertoire (et non pas son contenu) puis je tue le processus Mailpit :



- Je consulte l'état des pods de l'application :

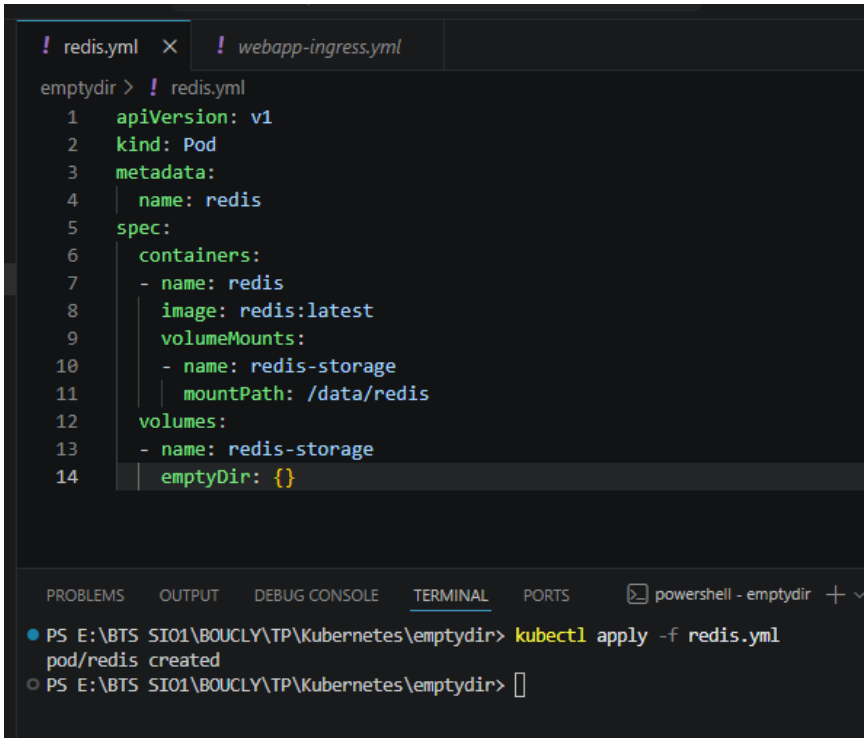
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl get pods -l app=mailpit
NAME                       READY   STATUS    RESTARTS      AGE
mailpit-7b96b48c5d-4h4tc   1/1     Running   1 (46s ago)   2m28s
PS C:\WINDOWS\system32>
```

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

```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> 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:\WINDOWS\system32>
```

10 – Persistance des données :

- Je crée le fichier de configuration du Pod redis.yaml et je crée le pod avec la commande kubectl apply -f :



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

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir> kubectl get pod redis --watch
NAME    READY   STATUS    RESTARTS   AGE
redis   1/1     Running   0          35s
```

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

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\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#
```

- J'installe procps (faire un apt-get update au préalable) puis je lsite les processus en cours d'exécution :

```
root@redis:/data/redis# apt-get update
Get:1 http://deb.debian.org/debian trixie InRelease [140 kB]
Get:2 http://deb.debian.org/debian trixie-updates InRelease [47.3 kB]
Get:3 http://deb.debian.org/debian-security trixie-security InRelease [43.4 kB]
Get:4 http://deb.debian.org/debian trixie/main amd64 Packages [9671 kB]
Get:5 http://deb.debian.org/debian trixie-updates/main amd64 Packages [5412 B]
Get:6 http://deb.debian.org/debian-security trixie-security/main amd64 Packages [132 kB]
Fetched 10.0 MB in 1s (7117 kB/s)
Reading package lists... Done
root@redis:/data/redis# apt-get install procps
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libgpm2 libncursesw6 libproc2-0 linux-sysctl-defaults psmisc
Suggested packages:
  gpm
The following NEW packages will be installed:
  libgpm2 libncursesw6 libproc2-0 linux-sysctl-defaults procps psmisc
0 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 1370 kB of archives.
After this operation, 4163 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
```

```
root@redis:/data/redis# ps aux
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
redis          1  0.0  0.3 160376 23424 ?        Ssl  08:51   0:00 redis-server *:6379
root          29  0.0  0.0   4320  3584 pts/0    Ss   08:52   0:00 /bin/bash
root          69  0.0  0.0      0     0 pts/0    Z    08:53   0:00 [dpkg-preconfigu] <defunct>
root         159  0.0  0.0   6388  3456 pts/0    R+   08:53   0:00 ps aux
root@redis:/data/redis#
```

- J’arrète le processus Redis :

```
root@redis:/data/redis# kill 1
root@redis:/data/redis# command terminated with exit code 137
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir>
```

- Je revins dans le premier terminal et je constate les changements apportés au Pod de Redis :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir> kubectl get pod redis --watch
NAME    READY   STATUS    RESTARTS      AGE
redis   1/1     Running   2 (14s ago)   5m45s
```

- J’accède à la console shell du conteneur redémarré et je constate que le fichier test-file est toujours présent dans le répertoire /data/redis :

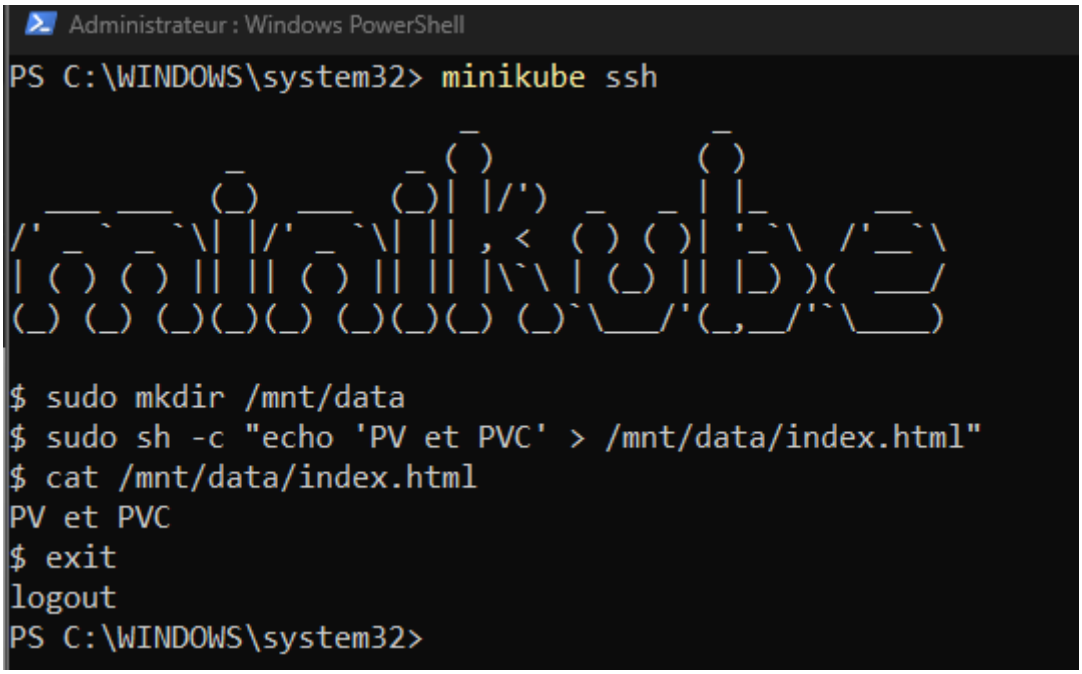
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir> kubectl exec -it redis -- /bin/bash
root@redis:/data# cd /data/redis/
root@redis:/data/redis# ls
test-file
root@redis:/data/redis# exit
exit
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir>
```

- Je supprime le pod :

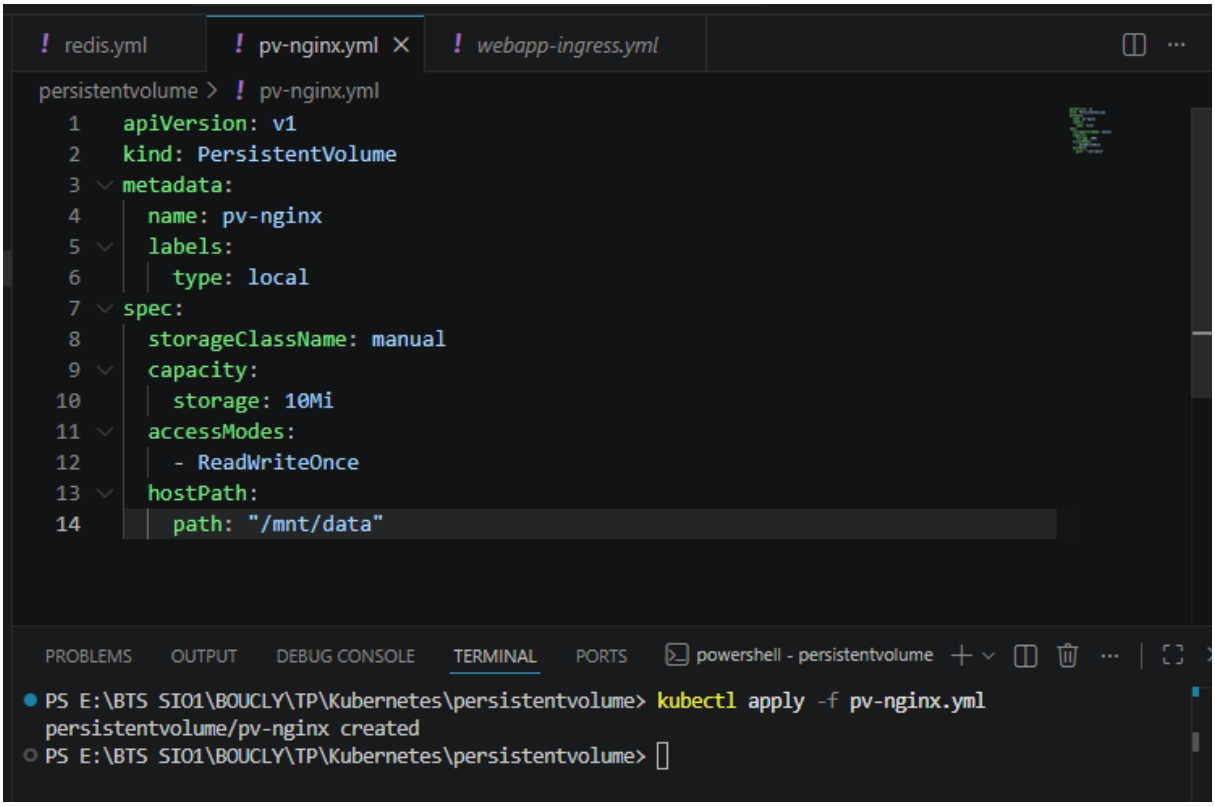
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir> kubectl delete pod redis
pod "redis" deleted from default namespace
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\emptydir> kubectl get pod redis --watch
NAME    READY   STATUS    RESTARTS   AGE
redis   1/1     Running   0          19s
redis   1/1     Terminating   0          50s
redis   1/1     Terminating   0          50s
redis   0/1     Completed     0          51s
redis   0/1     Completed     0          51s
redis   0/1     Completed     0          51s
```

- J'accède à minikube via la commande minikube ssh puis je crée un dossier /mnt/data. Dans le dossier /mnt/data, je crée un fichier index.html. Je teste l'existence du fichier index.html puis je ferme la session shell sur le nœud du cluster.

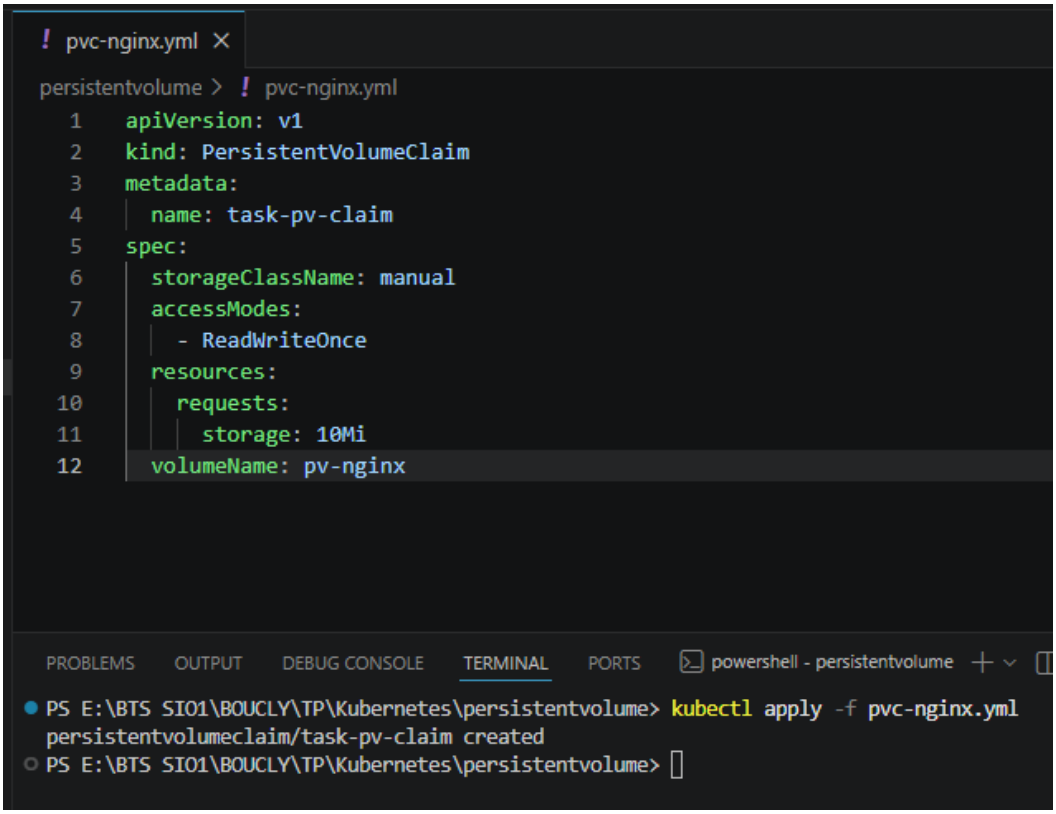


- Je crée un PersistentVolume de type hostpath :



```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl get pv pv-nginx
NAME       CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS      CLAIM   STORAGECLASS   VOLUMEATTRIB
UTESCLASS   REASON   AGE
pv-nginx   10Mi       RWO            Retain           Available           manual         <unset>
                    36s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume>
```

- Je crée un PersistentVolumeClaim (demande de stockage) :




```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl get pv pv-nginx
NAME       CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS   CLAIM                   STORAGECLASS
 VOLUMEATTRIBUTESCLASS   REASON   AGE
pv-nginx   10Mi       RWO            Retain           Bound    default/task-pv-claim   manual
 <unset>                          7m48s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl get pvc
NAME            STATUS   VOLUME     CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTESCLASS
AGE
task-pv-claim   Bound    pv-nginx   10Mi       RWO            manual         <unset>
61s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume>
```

- Je crée un Pod qui utilise le PersistentVolumeClaim comme volume de stockage :

pvc-nginx.yml | pvc-pod.yml | redis.yml

persistentvolume > pvc-pod.yml

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: task-pv-pod
spec:
  volumes:
    - name: task-pv-storage
      persistentVolumeClaim:
        claimName: tast-pv-claim
  containers:
    - name: task-pv-container
      image: nginx:latest
      ports:
        - containerPort: 80
          name: "http-server"
      volumeMounts:
        - mountPath: "/usr/share/nginx/html"
          name: task-pv-storage
```

PROBLEMS OUTPUT TERMINAL ... powershell - persistentvolume

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl apply -f pvc-pod.yml
pod/task-pv-pod created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl get pod task-pv-pod
NAME          READY   STATUS    RESTARTS   AGE
task-pv-pod   0/1     Pending   0          30s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl describe pod task-pv-pod
Name:             task-pv-pod
Namespace:        default
Priority:         0
Service Account:  default
Node:             <none>
Labels:           <none>
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
```

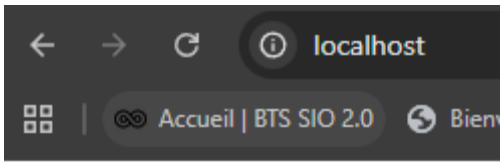
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl get pod task-pv-pod
NAME          READY   STATUS    RESTARTS   AGE
task-pv-pod   0/1     Pending   0          5m27s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume>
```

- Je décris le pod :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl describe pod task-pv-pod
Name:             task-pv-pod
Namespace:        default
Priority:         0
Service Account:  default
Node:             <none>
Labels:           <none>
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Containers:
  task-pv-container:
    Image:        nginx:latest
    Port:         80/TCP (http-server)
    Host Port:    0/TCP (http-server)
    Environment:  <none>
    Mounts:
      /usr/share/nginx/html from task-pv-storage (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-29qsr (ro)
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  task-pv-storage:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
    ClaimName:  tast-pv-claim
    ReadOnly:   false
  kube-api-access-29qsr:
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl exec -it task-pv-pod -- /bin/bash
root@task-pv-pod:/#
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl port-forward task-pv-pod 80
Forwarding from 127.0.0.1:80 -> 80
Forwarding from [::1]:80 -> 80
Handling connection for 80
Handling connection for 80
```



PV et PVC

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\persistentvolume> kubectl exec -it task-pv-pod -- /bin/bash
root@task-pv-pod:/# apt-get update
Get:1 http://deb.debian.org/debian trixie InRelease [140 kB]
Get:2 http://deb.debian.org/debian trixie-updates InRelease [47.3 kB]
Get:3 http://deb.debian.org/debian-security trixie-security InRelease [43.4 kB]
Get:4 http://deb.debian.org/debian trixie/main amd64 Packages [9671 kB]
Get:5 http://deb.debian.org/debian trixie-updates/main amd64 Packages [5412 B]
Get:6 http://deb.debian.org/debian-security trixie-security/main amd64 Packages [132 kB]
Fetched 10.0 MB in 1s (6903 kB/s)
Reading package lists... Done
root@task-pv-pod:/# apt-get install curl
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
curl is already the newest version (8.14.1-2+deb13u2).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
root@task-pv-pod:/# curl http://localhost
PV et PVC
root@task-pv-pod:/#
```

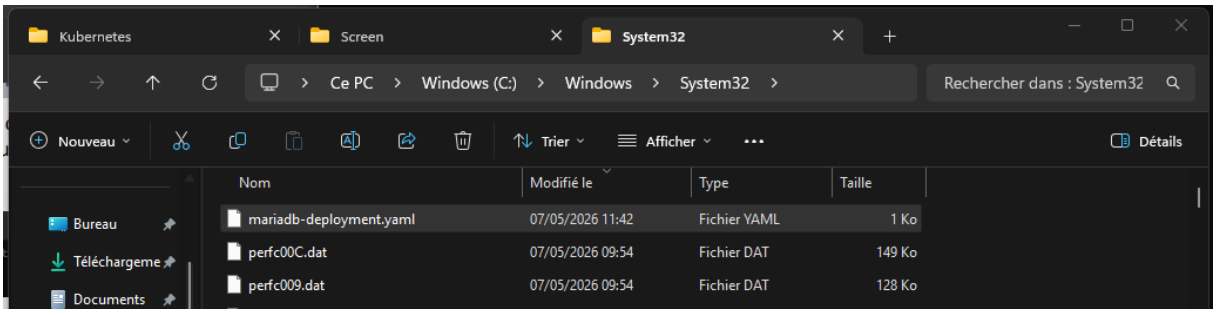
11 – Hébergement d'un groupe de pods fonctionnant en cluster :

- Version initiale du fichier de déploiement mariadb-deployment.yaml :

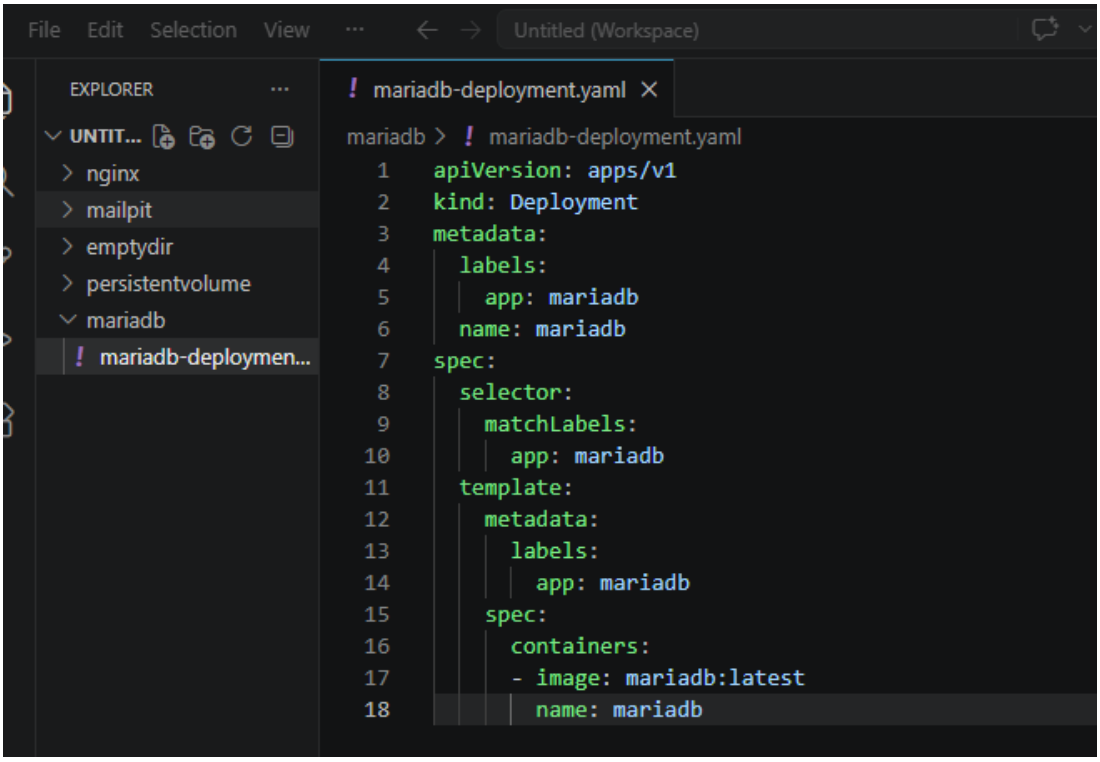
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl create deployment mariadb --image=mariadb:latest --dry-run=client --outp
ut yaml > mariadb-deployment.yaml
PS C:\WINDOWS\system32>
```

- Option --dry-run pour ne pas créer directement le déploiement

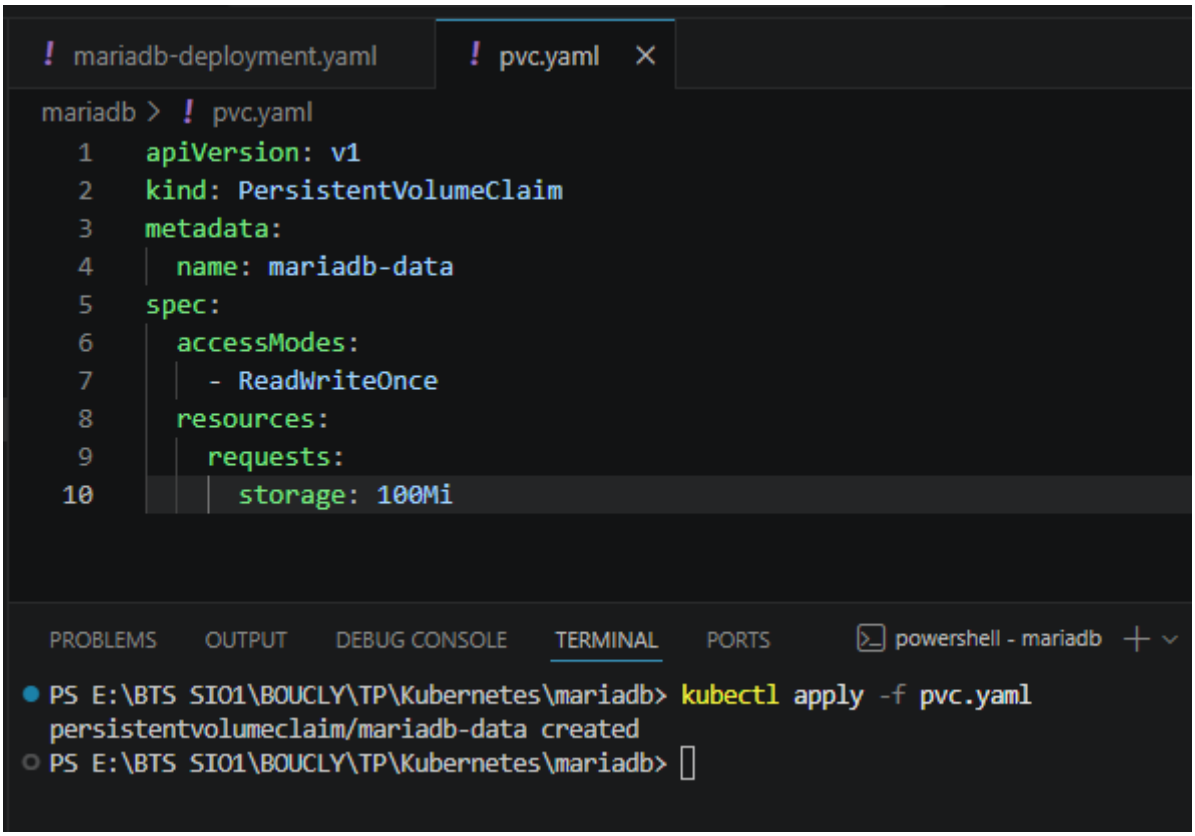
- Option --output yaml pour obtenir le résultat au format YAML



- Je supprime des champs inutiles :



- Demande de volume persistant :



- Etat de la demande de volume persistant :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pvc mariadb-data
NAME           STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGEC
LASS   VOLUMEATTRIBUTESCLASS   AGE
mariadb-data   Bound    pvc-cfed9380-d842-4e03-9b92-ac86868e5304   100Mi      RWO            standard
       <unset>                 37s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Indication au conteneur de MariaDB d'utiliser le volume persistant :

mariadb-deployment.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app: mariadb
  name: mariadb
spec:
  selector:
    matchLabels:
      app: mariadb
  template:
    metadata:
      labels:
        app: mariadb
    spec:
      volumes:
        - name: mariadb-data
          persistentVolumeClaim:
            claimName: mariadb-data
      containers:
      - image: mariadb:latest
        name: mariadb
        volumeMounts:
            - mountPath: /var/lib/mysql
              name: mariadb-data
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  powershell - mariadb

PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f mariadb-deployment.yaml
deployment.apps/mariadb created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Le répertoire /var/lib/mysql est l'emplacement standard où sont stockés les fichiers des bases de données.

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS             RESTARTS      AGE
mariadb-5c476b5c79-sc5w5   0/1     CrashLoopBackOff   1 (14s ago)   31s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS    RESTARTS      AGE
mariadb-5c476b5c79-sc5w5   0/1     Error     3 (25s ago)   56s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- J'affiche les logs :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl logs -l app=mariadb
2026-05-07 09:56:23+00:00 [Note] [Entrypoint]: Entrypoint script for MariaDB Server 1:12.2.2+maria~ubu2404 started.
2026-05-07 09:56:23+00:00 [Warn] [Entrypoint]: /sys/fs/cgroup///memory.pressure not writable, functionality unavailable to MariaDB
2026-05-07 09:56:23+00:00 [Note] [Entrypoint]: Switching to dedicated user 'mysql'
2026-05-07 09:56:23+00:00 [Note] [Entrypoint]: Entrypoint script for MariaDB Server 1:12.2.2+maria~ubu2404 started.
2026-05-07 09:56:23+00:00 [ERROR] [Entrypoint]: Database is uninitialized and password option is not specified
        You need to specify one of MARIADB_ROOT_PASSWORD, MARIADB_ROOT_PASSWORD_HASH, MARIADB_ALLOW_EMPTY_ROOT_PASSWORD and MARIADB_RANDOM_ROOT_PASSWORD
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Lors du premier démarrage, MariaDB a besoin de connaître le mot de passe de l'administrateur (champ env dans la définition du conteneur) :

```
25              name: mariadb-data
26          env:
27              - name: MARIADB_ROOT_PASSWORD
28                value: mot-de-passe-root
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS   powershell - mariadb
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f mariadb-deployment.yaml
deployment.apps/mariadb configured
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS    RESTARTS   AGE
mariadb-5bbb9c9b6d-r5ch5   1/1     Running   0          22s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- je me connecte au conteneur afin de tester le fonctionnement de la bdd (commande mariadb-admin status). Cette commande sera utilisée pour mettre en place la surveillance de l'état du pod (liveness et readiness).

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl exec -it deployment/mariadb -- bash
root@mariadb-5bbb9c9b6d-r5ch5:/# mariadb-admin status -p$MARIADB_ROOT_PASSWORD
Uptime: 83  Threads: 1  Questions: 1  Slow queries: 0  Opens: 17  Open tables: 10  Queries per second
 avg: 0.012
root@mariadb-5bbb9c9b6d-r5ch5:/# exirt
bash: exirt: command not found
root@mariadb-5bbb9c9b6d-r5ch5:/# exit
exit
command terminated with exit code 127
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je crée le service (fichier service.yaml) :

```yaml
apiVersion: v1
kind: Service
metadata:
  labels:
    app: mariadb
  name: mariadb
spec:
  ports:
  - name: mysql
    port: 3306
    protocol: TCP
    targetPort: 3306
  selector:
    app: mariadb
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  powershell - mariadb

PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f service.yaml
service/mariadb created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je surveille la base de données :

```
28                value: mot-de-passe-root
29          startupProbe: &probe
30              exec:
31                command:
32                  - "sh"
33                  - "-c"
34                  - "mariadb-admin status -p$MARIADB_ROOT_PASSWORD"
35          livenessProbe: *probe
36          readinessProbe: *probe
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS   powershell - mariadb
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f mariadb-deployment.yaml
deployment.apps/mariadb configured
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS    RESTARTS      AGE
mariadb-5bbb9c9b6d-r5ch5   1/1     Running   0             8m58s
mariadb-6574478f7f-kpsnq   0/1     Running   1 (17s ago)   49s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je décris le pod :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl describe pods mariadb-6574478f7f-kpsnq
Name:             mariadb-6574478f7f-kpsnq
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/172.21.116.204
Start Time:       Thu, 07 May 2026 12:06:25 +0200
Labels:           app=mariadb
                  pod-template-hash=6574478f7f
Annotations:      <none>
Status:           Running
IP:               10.244.0.14
IPs:
  IP:           10.244.0.14
Controlled By:  ReplicaSet/mariadb-6574478f7f
Containers:
  mariadb:
    Container ID:   docker://7872778e657fcc2ae38f754746c5b53f492e158d84a6f6f47a6e3a084c5fa035
    Image:          mariadb:latest
    Image ID:       docker-pullable://mariadb@sha256:e0236fc6386e7eacd9359e59d0a078bd7aa0d18280d36d13
061121bedeaee903
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Thu, 07 May 2026 12:08:34 +0200
    Last State:     Terminated
      Reason:       Error
      Exit Code:    1
      Started:      Thu, 07 May 2026 12:08:02 +0200
      Finished:     Thu, 07 May 2026 12:08:33 +0200
    Ready:          False
    Restart Count:  4
```

```
Conditions:
  Type                        Status
  PodReadyToStartContainers   True
  Initialized                 True
  Ready                       False
  ContainersReady             False
  PodScheduled                True
Volumes:
  mariadb-data:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
    ClaimName:  mariadb-data
    ReadOnly:   false
  kube-api-access-gdhjx:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    Optional:                false
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason     Age                From               Message
  ----     ------     ----               ----               -------
  Normal   Scheduled  2m22s              default-scheduler  Successfully assigned default/mariadb-6
574478f7f-kpsnq to minikube
  Normal   Pulled     2m20s              kubelet            Successfully pulled image "mariadb:late
st" in 925ms (925ms including waiting). Image size: 335568219 bytes.
  Normal   Pulled     109s               kubelet            Successfully pulled image "mariadb:late
```

```
  Normal   Pulled     13s                kubelet            Successfully pulled image "mariadb:late
st" in 922ms (922ms including waiting). Image size: 335568219 bytes.
  Warning  Unhealthy  1s (x14 over 2m11s)  kubelet          Startup probe failed: mariadb-admin: co
nnect to server at 'localhost' failed
error: 'Can't connect to local server through socket '/run/mysqld/mysqld.sock' (2)'
Check that mariadbd is running and that the socket: '/run/mysqld/mysqld.sock' exists!
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- J'affiche les logs :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl logs mariadb-6574478f7f-kpsnq
2026-05-07 10:10:32+00:00 [Note] [Entrypoint]: Entrypoint script for MariaDB Server 1:12.2.2+maria~ub
u2404 started.
2026-05-07 10:10:32+00:00 [Warn] [Entrypoint]: /sys/fs/cgroup///memory.pressure not writable, functio
nality unavailable to MariaDB
2026-05-07 10:10:32+00:00 [Note] [Entrypoint]: Switching to dedicated user 'mysql'
2026-05-07 10:10:32+00:00 [Note] [Entrypoint]: Entrypoint script for MariaDB Server 1:12.2.2+maria~ub
u2404 started.
2026-05-07 10:10:32+00:00 [Note] [Entrypoint]: MariaDB upgrade not required
2026-05-07 10:10:32 0 [Note] Starting MariaDB 12.2.2-MariaDB-ubu2404 source revision d26a6f44c1f21193
77e79a9540886c6d8c01472f server_uid 3ZyNBUyhjiwfnr6ko6tg/Fa1OhY= as process 1
2026-05-07 10:10:32 0 [ERROR] mariadbd: Can't lock aria control file '/var/lib/mysql/aria_log_control
' for exclusive use, error: 11. Will retry for 30 seconds
2026-05-07 10:11:02 0 [ERROR] mariadbd: Got error 'Could not get an exclusive lock; file is probably
in use by another process' when trying to use aria control file '/var/lib/mysql/aria_log_control'
2026-05-07 10:11:02 0 [ERROR] Plugin 'Aria' registration as a STORAGE ENGINE failed.
2026-05-07 10:11:02 0 [Note] InnoDB: Compressed tables use zlib 1.3
2026-05-07 10:11:02 0 [Note] InnoDB: Number of transaction pools: 1
2026-05-07 10:11:02 0 [Note] InnoDB: Using crc32 + pclmulqdq instructions
2026-05-07 10:11:02 0 [Note] mariadbd: O_TMPFILE is not supported on /tmp (disabling future attempts)
2026-05-07 10:11:02 0 [Note] InnoDB: Using io_uring
2026-05-07 10:11:02 0 [Note] InnoDB: innodb_buffer_pool_size_max=128m, innodb_buffer_pool_size=128m
2026-05-07 10:11:02 0 [Note] InnoDB: Completed initialization of buffer pool
2026-05-07 10:11:02 0 [Note] InnoDB: File system buffers for log disabled (block size=512 bytes)
2026-05-07 10:11:02 0 [ERROR] InnoDB: Unable to lock ./ibdata1 error: 11
2026-05-07 10:11:02 0 [Note] InnoDB: Check that you do not already have another mariadbd process usin
g the same InnoDB data or log files.
2026-05-07 10:11:02 0 [ERROR] InnoDB: Plugin initialization aborted with error Generic error
2026-05-07 10:11:02 0 [Note] InnoDB: Starting shutdown...
2026-05-07 10:11:02 0 [ERROR] Plugin 'InnoDB' registration as a STORAGE ENGINE failed.
2026-05-07 10:11:02 0 [Note] Plugin 'FEEDBACK' is disabled.
```

- Le conteneur n'arrive pas à démarrer en raison de la présence d'un lock dans les fichiers de bdd. Ce lock s'explique en raison du fait qu'un pod est déjà démarré et que celui-ci utilise déjà ces fichiers.

- Le problème vient du fait qu'une bdd ne peut pas partager ses fichiers :

```
  name: mariadb
spec:
  selector:
    matchLabels:
      app: mariadb
  strategy:
    type: Recreate
  template:
    metadata:
      labels:
        app: mariadb
    spec:
      volumes:
        - name: mariadb-data
          persistentVolumeClaim:
```

- J'applique le fichier yaml :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f mariadb-deployment.yaml
deployment.apps/mariadb configured
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb --watch
NAME                       READY   STATUS             RESTARTS      AGE
mariadb-6574478f7f-kpsnq   0/1     CrashLoopBackOff   7 (66s ago)   9m2s
```

- Dans le cas où le pod reste dans l'état CrashLoopBackOff, ne pas hésiter à supprimer le pod :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS             RESTARTS       AGE
mariadb-6574478f7f-kpsnq   0/1     CrashLoopBackOff   7 (112s ago)   9m48s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl delete pods -l app=mariadb
pod "mariadb-6574478f7f-kpsnq" deleted from default namespace
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Le pod est bien lancer :

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pod -l app=mariadb
NAME                       READY   STATUS    RESTARTS   AGE
mariadb-6574478f7f-xvjfj   1/1     Running   0          25s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

Mise en place d'un StatefulSet :

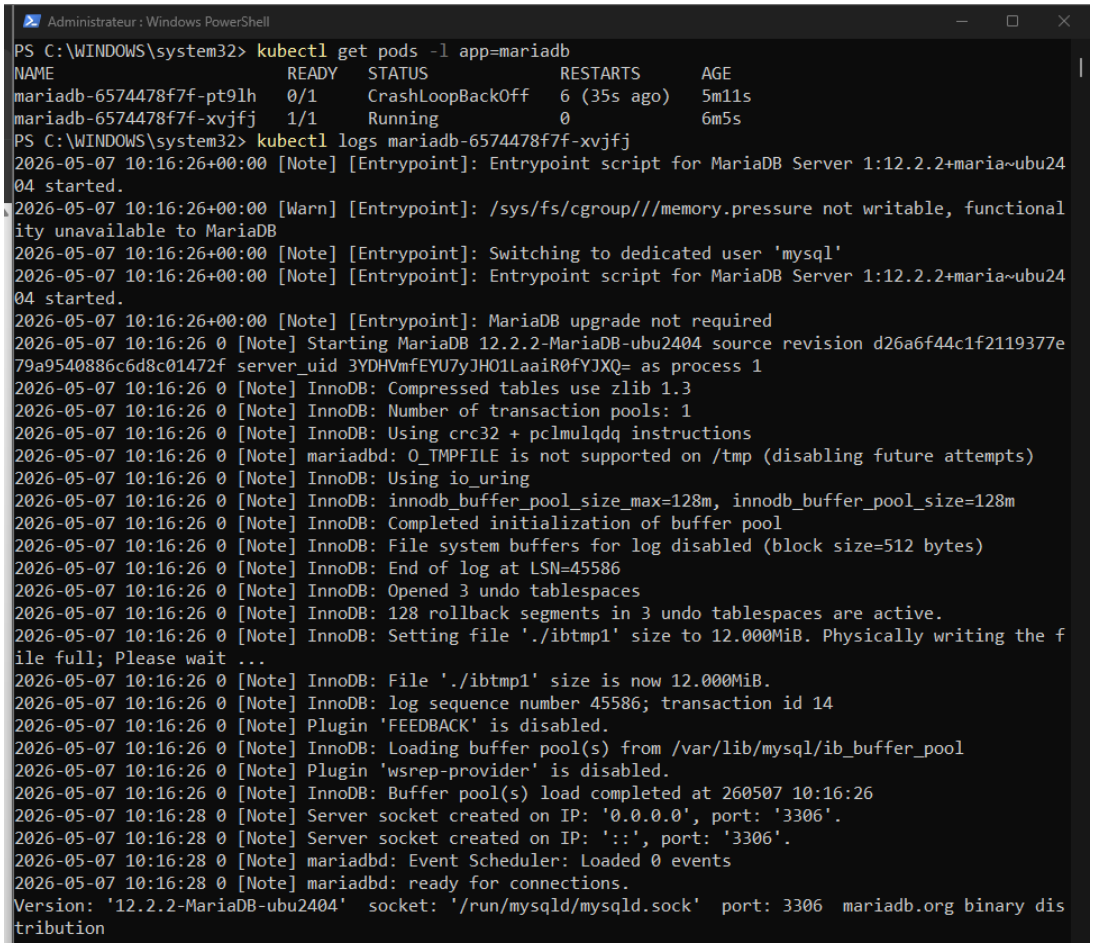
- J'augmente le nombre de pods associés au déploiement et montée en charge automatique :

```
PS C:\WINDOWS\system32> kubectl scale deployment mariadb --replicas=2
deployment.apps/mariadb scaled
PS C:\WINDOWS\system32> kubectl pods -l app=mariadb --watch
error: unknown command "pods" for "kubectl"

Did you mean this?
        logs
PS C:\WINDOWS\system32> kubectl get pods -l app=mariadb --watch
NAME                       READY   STATUS    RESTARTS      AGE
mariadb-6574478f7f-pt9lh   0/1     Running   0             26s
mariadb-6574478f7f-xvjfj   1/1     Running   0             80s
mariadb-6574478f7f-pt9lh   0/1     Running   1 (2s ago)    34s
mariadb-6574478f7f-pt9lh   0/1     Running   2 (1s ago)    65s
```

- Le nouveau pod n'arrive pas à démarrer :

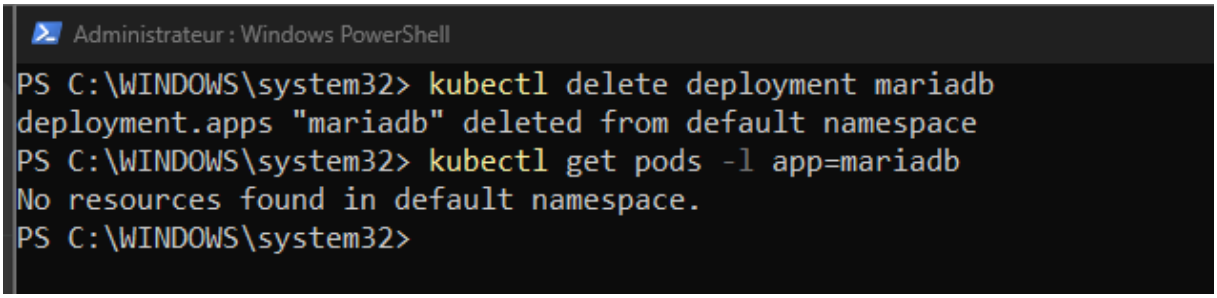
```
Administrateur : Windows PowerShell
PS C:\WINDOWS\system32> kubectl describe pods mariadb-6574478f7f-xvjfj
Name:             mariadb-6574478f7f-xvjfj
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/172.21.116.204
Start Time:       Thu, 07 May 2026 12:16:24 +0200
Labels:           app=mariadb
                  pod-template-hash=6574478f7f
Annotations:      <none>
Status:           Running
IP:               10.244.0.15
IPs:
  IP:           10.244.0.15
Controlled By:  ReplicaSet/mariadb-6574478f7f
Containers:
  mariadb:
    Container ID:   docker://3889079a1178d3f57edacaebb1e99788ae37099c237f52e8c526af776a318604
    Image:          mariadb:latest
    Image ID:       docker-pullable://mariadb@sha256:e0236fc6386e7eacd9359e59d0a078bd7aa0d18280d36d13061
121bedeaee903
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Thu, 07 May 2026 12:16:25 +0200
    Ready:          True
    Restart Count:  0
    Liveness:       exec [sh -c mariadb-admin status -p$MARIADB_ROOT_PASSWORD] delay=0s timeout=1s perio
d=10s #success=1 #failure=3
    Readiness:      exec [sh -c mariadb-admin status -p$MARIADB_ROOT_PASSWORD] delay=0s timeout=1s perio
d=10s #success=1 #failure=3
    Startup:        exec [sh -c mariadb-admin status -p$MARIADB_ROOT_PASSWORD] delay=0s timeout=1s perio
d=10s #success=1 #failure=3
    Environment:
```

```
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  4m58s  default-scheduler  Successfully assigned default/mariadb-6574478f7f-xvjfj to
 minikube
  Normal  Pulling    4m58s  kubelet            Pulling image "mariadb:latest"
  Normal  Pulled     4m57s  kubelet            Successfully pulled image "mariadb:latest" in 924ms (924m
s including waiting). Image size: 335568219 bytes.
  Normal  Created    4m57s  kubelet            Container created
  Normal  Started    4m56s  kubelet            Container started
PS C:\WINDOWS\system32>
```

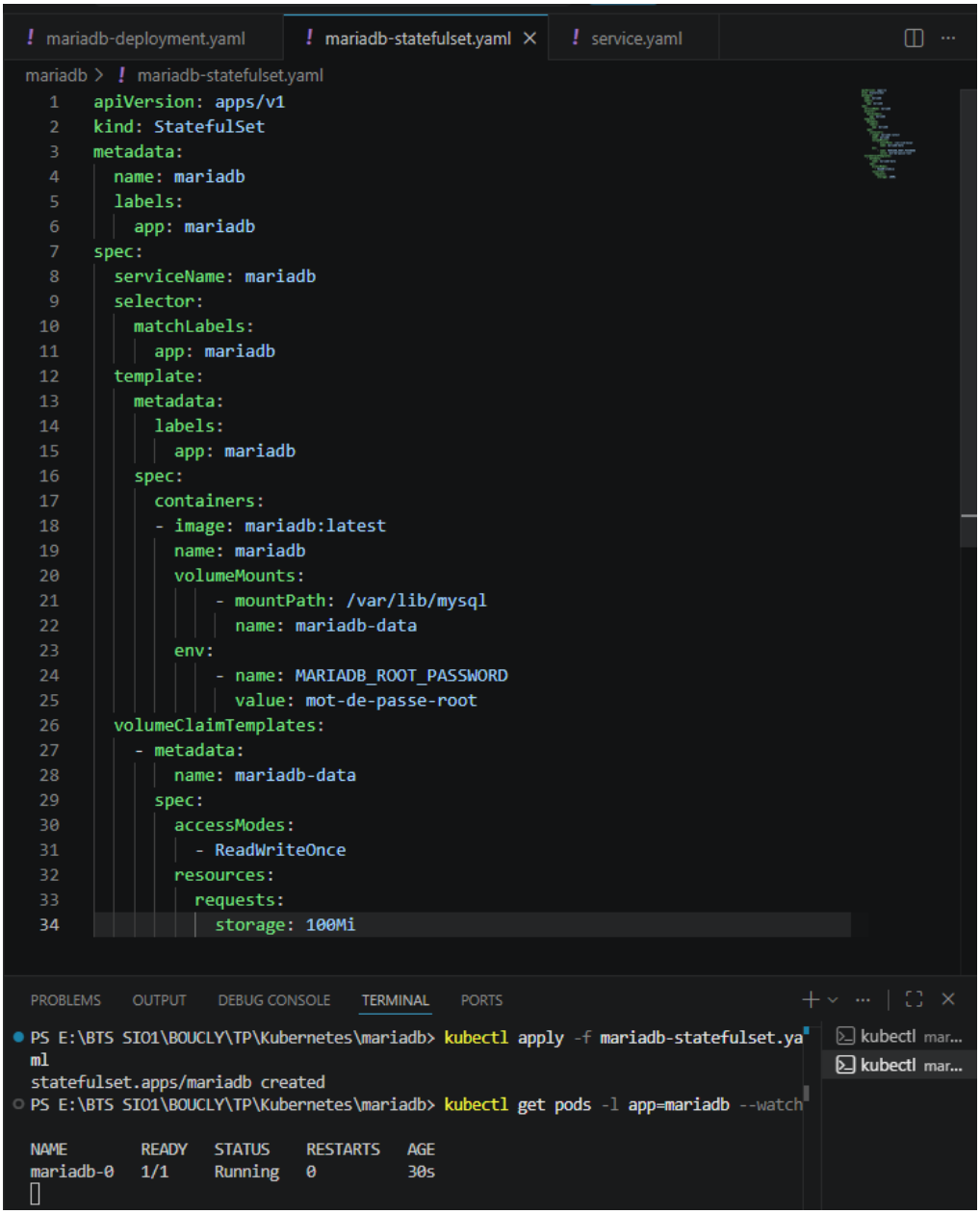


- Le problème est tout à fait normal puisqu'une base de données s'attend à avoir un accès exclusif à ses fichiers

- je purge l'ancien déploiement de MariaDB :



- Je modifie le fichier mariadb-deployment.yaml et je le sauvegarde sous le nom mariadbstatefulset.yaml :



- Je crée le StatefulSet et je consulte l'état des pods associés au Statefulset de MariaDB :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pvc
NAME                     STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
mariadb-data             Bound    pvc-cfed9380-d842-4e03-9b92-ac86868e5304   100Mi      RWO            standard       <unset>                 41m
mariadb-data-mariadb-0   Bound    pvc-2b209f52-9dfc-4b8b-81fd-f9e07a46088a   100Mi      RWO            standard       <unset>                 83s
task-pv-claim            Bound    pv-nginx                                   10Mi       RWO            manual         <unset>                 76m
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je consulte l'état des demandes de volumes persistants :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pv
NAME                                       CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS   CLAIM
                        STORAGECLASS   VOLUMEATTRIBUTESCLASS   REASON   AGE
pv-nginx                                   10Mi       RWO            Retain           Bound    defaul
t/task-pv-claim         manual         <unset>                          84m
pvc-2b209f52-9dfc-4b8b-81fd-f9e07a46088a   100Mi      RWO            Delete           Bound    defaul
t/mariadb-data-mariadb-0   standard       <unset>                          2m48s
pvc-cfed9380-d842-4e03-9b92-ac86868e5304   100Mi      RWO            Delete           Bound    defaul
t/mariadb-data          standard       <unset>                          43m
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je note que l'ancien objet mariadb-data de type PVC est toujours présent. Il ne servira plus. Je le supprime :

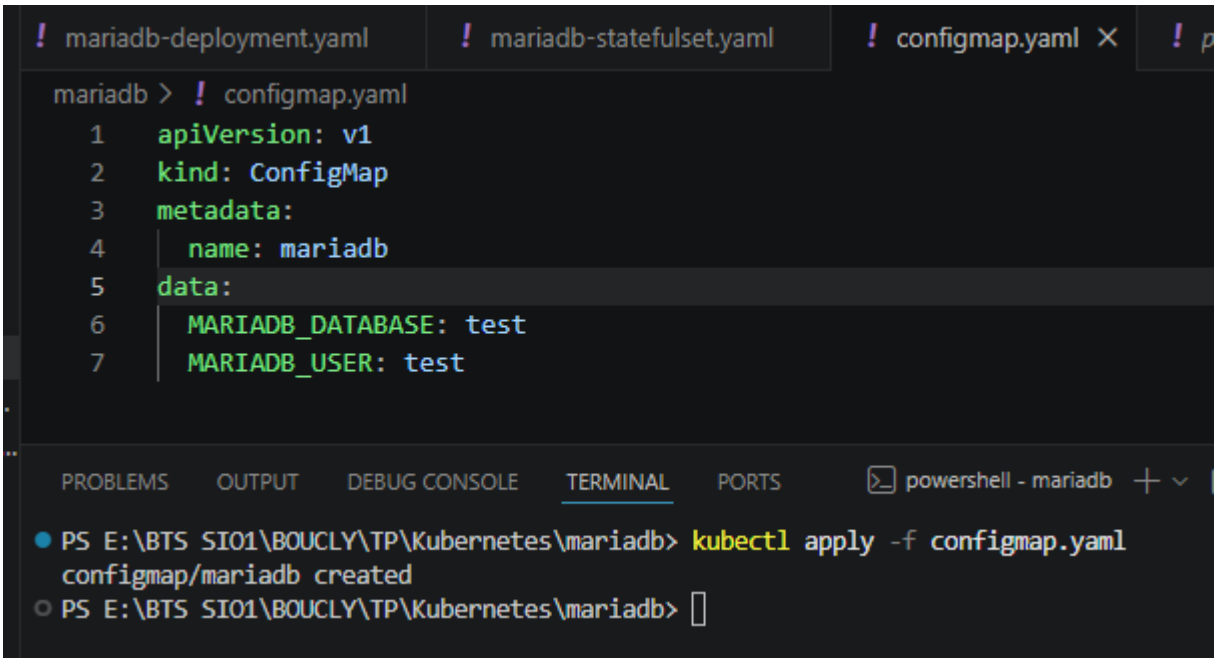
```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl delete pvc/mariadb-data
persistentvolumeclaim "mariadb-data" deleted from default namespace
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

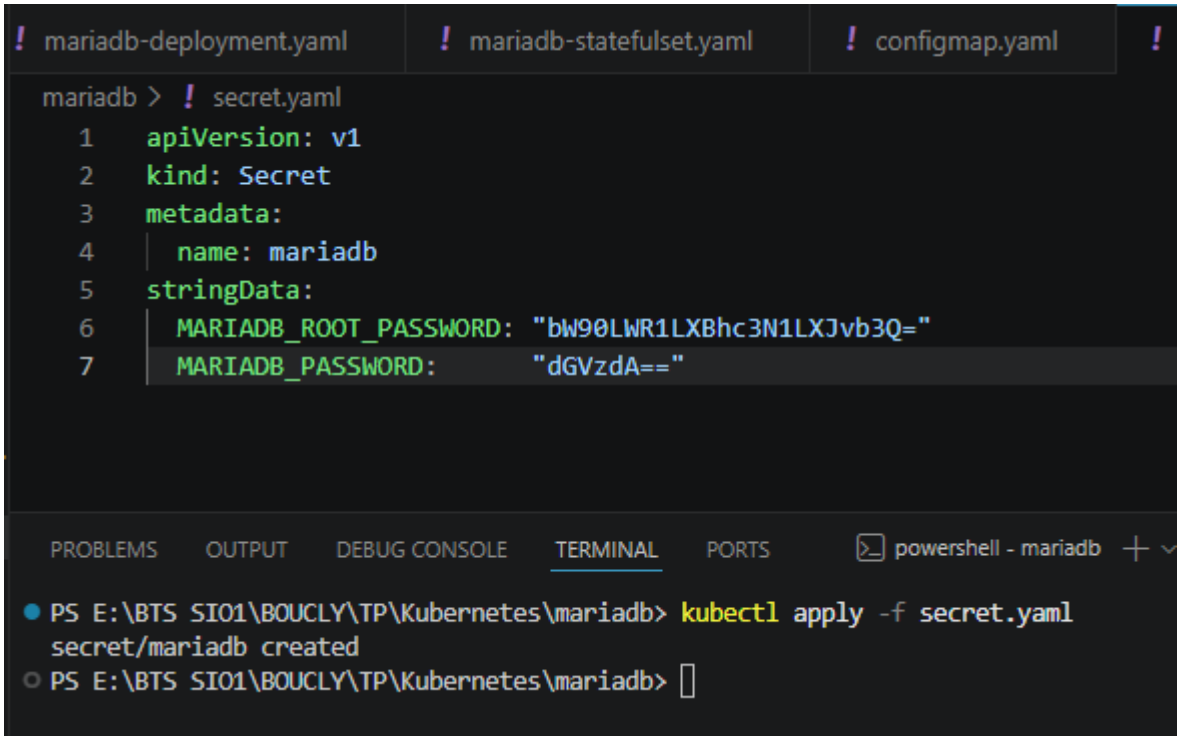
- Scalabilité de l'objet StatefulSet :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl scale sts mariadb --replicas=2
statefulset.apps/mariadb scaled
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```

- Je consulte les demandes de volumes persistants et les pods :

```
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pvc -l app=mariadb
NAME                     STATUS   VOLUME                                     CAPACITY   ACCESS MODES
  STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
mariadb-data-mariadb-0   Bound    pvc-2b209f52-9dfc-4b8b-81fd-f9e07a46088a   100Mi      RWO
  standard       <unset>                 4m20s
mariadb-data-mariadb-1   Bound    pvc-03a2cafd-e7b0-48c3-baec-0a271ba29a8a   100Mi      RWO
  standard       <unset>                 29s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pods -l app=mariadb
NAME        READY   STATUS    RESTARTS   AGE
mariadb-0   1/1     Running   0          4m39s
mariadb-1   1/1     Running   0          48s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl get pods,pvc -l app=mariadb
NAME              READY   STATUS    RESTARTS   AGE
pod/mariadb-0     1/1     Running   0          4m52s
pod/mariadb-1     1/1     Running   0          61s

NAME                                          STATUS   VOLUME                                     CA
PACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
persistentvolumeclaim/mariadb-data-mariadb-0   Bound    pvc-2b209f52-9dfc-4b8b-81fd-f9e07a46088a   10
0Mi      RWO            standard       <unset>                 4m52s
persistentvolumeclaim/mariadb-data-mariadb-1   Bound    pvc-03a2cafd-e7b0-48c3-baec-0a271ba29a8a   10
0Mi      RWO            standard       <unset>                 61s
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>
```


mariadb-deployment.yaml
mariadb-statefulset.yaml
configmap.yaml
mariadb > configmap.yaml
1 apiVersion: v1
2 kind: ConfigMap
3 metadata:
4 name: mariadb
5 data:
6 MARIADB_DATABASE: test
7 MARIADB_USER: test
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
powershell - mariadb
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f configmap.yaml
configmap/mariadb created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>


mariadb-deployment.yaml
mariadb-statefulset.yaml
configmap.yaml
mariadb > secret.yaml
1 apiVersion: v1
2 kind: Secret
3 metadata:
4 name: mariadb
5 stringData:
6 MARIADB_ROOT_PASSWORD: "bW90LWR1LXBhc3N1LXJvb3Q="
7 MARIADB_PASSWORD: "dGVzdA=="
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
powershell - mariadb
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb> kubectl apply -f secret.yaml
secret/mariadb created
PS E:\BTS SIO1\BOUCLY\TP\Kubernetes\mariadb>

- Rattachement au conteneur :