PV and PVCS

```
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
deployment.apps/nginx-deployment created
controlplane:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
deploy                              1/1     Running   0          2m58s
nginx-deployment-86c57bc6b8-8svbw   1/1     Running   0          5s
nginx-deployment-86c57bc6b8-k7fr4   1/1     Running   0          5s
controlplane:~$ kubectl delete pod deploy
pod "deploy" deleted
controlplane:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-86c57bc6b8-8svbw   1/1     Running   0          23s
nginx-deployment-86c57bc6b8-k7fr4   1/1     Running   0          23s
controlplane:~$ kubectl exec -it nginx-deployment-86c57bc6b8-8svbw -- bin/bash
root@nginx-deployment-86c57bc6b8-8svbw:/# ls
bin   dev                  docker-entrypoint.sh  home  lib64  mnt  proc  run   srv  tmp  var
boot  docker-entrypoint.d  etc                   lib   media  opt  root  sbin  sys  usr
root@nginx-deployment-86c57bc6b8-8svbw:/# touch f1 f2 f3 f4
root@nginx-deployment-86c57bc6b8-8svbw:/# ls
bin   dev                  docker-entrypoint.sh  f1  f3  home  lib64  mnt  proc  run   srv  tmp  var
boot  docker-entrypoint.d  etc                   f2  f4  lib   media  opt  root  sbin  sys  usr
root@nginx-deployment-86c57bc6b8-8svbw:/# exit
exit
controlplane:~$ kubectl delete pod nginx-deployment-86c57bc6b8-8svbw
pod "nginx-deployment-86c57bc6b8-8svbw" deleted
controlplane:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-86c57bc6b8-k7fr4   1/1     Running   0          113s
nginx-deployment-86c57bc6b8-rs9pp   1/1     Running   0          5s
controlplane:~$ kubectl exec -it nginx-deployment-86c57bc6b8-rs9pp -- bin/bash
root@nginx-deployment-86c57bc6b8-rs9pp:/# ls
bin   dev                  docker-entrypoint.sh  home  lib64  mnt  proc  run   srv  tmp  var
boot  docker-entrypoint.d  etc                   lib   media  opt  root  sbin  sys  usr
root@nginx-deployment-86c57bc6b8-rs9pp:/#
```

I created a Deployment, which in turn created multiple replicas (Pods). I exec'd into one of the Pods and created some files. However, when the Pod was deleted for some reason, the Deployment created a new Pod in its place, and I couldn't find the previously created files. This is because Pods are ephemeral, and their data is lost when they're deleted. To persist application data, we need to

use persistent storage

```yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: example-pv
spec:
  capacity:
    storage: 5Gi
  accessModes:
    - ReadWriteOnce
  persistentVolumeReclaimPolicy: Retain
  local:
    path: /mnt/data
~
~
~
~
~
~
~
~
~
~
```

```yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: example-pvc
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 5Gi
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
  labels:
    app: nginx
spec:
  replicas: 2
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx
        ports:
        - containerPort: 80
        volumeMounts:
        - mountPath: "/usr/share/nginx/html"
          name: mypd
     volumes:
     - name: mypd
       persistentVolumeClaim:
        claimName: example-pvc
~
```

```
controlplane:~$ vi pv.yaml
controlplane:~$ kubectl apply -f pv.yaml
The PersistentVolume "example-pv" is invalid: spec.nodeAffinity: Required value: Local volume requires node affinity
controlplane:~$ vi pv.yaml
controlplane:~$ kubectl apply -f pv.yaml
persistentvolume/example-pv created
controlplane:~$ kubectl get deploy
NAME               READY   UP-TO-DATE   AVAILABLE   AGE
nginx-deployment   2/2     2            2           17m
controlplane:~$ kubectl delete deploy nginx-deployment
deployment.apps "nginx-deployment" deleted
controlplane:~$ vi pvc.yaml
controlplane:~$ kubectl apply -f pvc.yaml
persistentvolumeclaim/example-pvc created
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
deployment.apps/nginx-deployment created
controlplane:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-86c57bc6b8-b5xnb   1/1     Running   0          7s
nginx-deployment-86c57bc6b8-z6x97   1/1     Running   0          7s
controlplane:~$ kubectl exec -it nginx-deployment-86c57bc6b8-b5xnb -- bin/bash
root@nginx-deployment-86c57bc6b8-b5xnb:/# cd usr/share/nginx/html
root@nginx-deployment-86c57bc6b8-b5xnb:/usr/share/nginx/html# ls
50x.html  index.html
root@nginx-deployment-86c57bc6b8-b5xnb:/usr/share/nginx/html# exit
exit
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
error: error parsing deploy.yaml: error converting YAML to JSON: yaml: line 24: did not find expected key
controlplane:~$ vi deploy.yaml
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
The request is invalid: patch: Invalid value: "map[metadata:map[annotations:map[kubectl.kubernetes.io/last-applied-configurat
spec.template.volumes
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
deployment.apps/example-deployment created
controlplane:~$ kubectl get pods
NAME                                  READY   STATUS              RESTARTS   AGE
example-deployment-6df4b75457-ff6jr   0/1     ContainerCreating   0          8s
nginx-deployment-86c57bc6b8-b5xnb     1/1     Running             0          12m
nginx-deployment-86c57bc6b8-z6x97     1/1     Running             0          12m
controlplane:~$ kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
example-deployment-6df4b75457-ff6jr   1/1     Running   0          18s
nginx-deployment-86c57bc6b8-b5xnb     1/1     Running   0          12m
nginx-deployment-86c57bc6b8-z6x97     1/1     Running   0          12m
controlplane:~$
controlplane:~$ vi deploy.yaml
controlplane:~$ kubectl apply -f deploy.yaml
deployment.apps/example-deployment configured
controlplane:~$ kubectl get pods
NAME                                  READY   STATUS    RESTARTS   AGE
example-deployment-6df4b75457-7gsgx   1/1     Running   0          13s
example-deployment-6df4b75457-ff6jr   1/1     Running   0          63s
nginx-deployment-86c57bc6b8-b5xnb     1/1     Running   0          13m
nginx-deployment-86c57bc6b8-z6x97     1/1     Running   0          13m
controlplane:~$ kubectl exec -it example-deployment-6df4b75457-7gsgx -- bin/bash
root@example-deployment-6df4b75457-7gsgx:/# ls
bin   dev                  docker-entrypoint.sh  home  lib64  mnt  proc  run   srv  tmp  var
boot  docker-entrypoint.d  etc                   lib   media  opt  root  sbin  sys  usr
root@example-deployment-6df4b75457-7gsgx:/# cd usr/share/nginx/html
root@example-deployment-6df4b75457-7gsgx:/usr/share/nginx/html# ls
root@example-deployment-6df4b75457-7gsgx:/usr/share/nginx/html# touch f1 f2 f3
root@example-deployment-6df4b75457-7gsgx:/usr/share/nginx/html# ls
f1  f2  f3
root@example-deployment-6df4b75457-7gsgx:/usr/share/nginx/html# exit
exit
```

```
controlplane:~$ kubectl get pods
NAME                                    READY   STATUS    RESTARTS   AGE
example-deployment-6df4b75457-ff6jr     1/1     Running   0          3m11s
example-deployment-6df4b75457-w4w29     1/1     Running   0          7s
nginx-deployment-86c57bc6b8-b5xnb       1/1     Running   0          15m
nginx-deployment-86c57bc6b8-z6x97       1/1     Running   0          15m
controlplane:~$ kubectl exec -it example-deployment-6df4b75457-w4w29 -- bin/bash
root@example-deployment-6df4b75457-w4w29:/# cd usr/shar/nginx/html
bash: cd: usr/shar/nginx/html: No such file or directory
root@example-deployment-6df4b75457-w4w29:/# cd usr/share/nginx/html
root@example-deployment-6df4b75457-w4w29:/usr/share/nginx/html# ls
f1  f2  f3
root@example-deployment-6df4b75457-w4w29:/usr/share/nginx/html#
```

Using Persistent Volumes (PVs) and Persistent Volume Claims (PVCs), I created a hostPath volume that persists application data on one of the nodes in the Kubernetes cluster.

However, using hostPath volumes has drawbacks, such as data loss when a node fails. A better approach is to use StorageClasses, which enable dynamic provisioning of Persistent Volumes, providing scalability and flexibility. This way, storage can be provisioned and managed more efficiently, reducing the risk of data loss.

```
ubuntu@k8-master:~$ kubectl get pods -n kube-system -l app.kubernetes.io/name=aws-ebs-csi-driver
NAME                                  READY   STATUS    RESTARTS   AGE
ebs-csi-controller-68bd667f7b-lzw2r   0/5     Pending   0          21s
ebs-csi-controller-68bd667f7b-xlnvj   0/5     Pending   0          21s
ebs-csi-node-8rhcc                    0/3     Pending   0          21s
ebs-csi-node-99mhc                    0/3     Pending   0          21s
ebs-csi-node-zt2df                    3/3     Running   0          21s
ubuntu@k8-master:~$ vi sc.yaml
ubuntu@k8-master:~$ vi pvc.yaml
ubuntu@k8-master:~$ vi pvc1.yaml
ubuntu@k8-master:~$ vi deploy.yaml
ubuntu@k8-master:~$ vi deploy1.yaml
ubuntu@k8-master:~$ kubectl apply -f sc.yaml
storageclass.storage.k8s.io/ebs-sc created
ubuntu@k8-master:~$ kubectl get sc
NAME     PROVISIONER       RECLAIMPOLICY   VOLUMEBINDINGMODE      ALLOWVOLUMEEXPANSION   AGE
ebs-sc   ebs.csi.aws.com   Delete          WaitForFirstConsumer   false                  9s
ubuntu@k8-master:~$ kubectl apply -f pvc1.yaml
persistentvolumeclaim/ebs-claim created
ubuntu@k8-master:~$ kubectl get pvc
NAME          STATUS    VOLUME       CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
ebs-claim     Pending                                           ebs-sc         <unset>                 9s
example-pvc   Bound     example-pv   5Gi        RWO                           <unset>                 17m
ubuntu@k8-master:~$ kubectl apply -f deploy1.yaml
deployment.apps/nginx-deployment1 created
ubuntu@k8-master:~$ kubectl get pods
NAME                                READY   STATUS        RESTARTS   AGE
nginx-deployment-68bc55f4bd-2jcdx   1/1     Terminating   0          17m
nginx-deployment-68bc55f4bd-8zzt4   0/1     Pending       0          4m15s
nginx-deployment-68bc55f4bd-fgbnw   1/1     Terminating   0          17m
```

```
buntu@k8-master:~$ kubectl get pods
AME                                   READY   STATUS    RESTARTS   AGE
ginx-deployment1-75f9c5858-2t297   1/1     Running   0          4m28s
ginx-deployment1-75f9c5858-rr27s   1/1     Running   0          4m28s
buntu@k8-master:~$ kubectl exec -it nginx-deployment1-75f9c5858-2t297 -- bin/bash
oot@nginx-deployment1-75f9c5858-2t297:/# cd /usr/share/nginx/html
oot@nginx-deployment1-75f9c5858-2t297:/usr/share/nginx/html# ls
ost+found
oot@nginx-deployment1-75f9c5858-2t297:/usr/share/nginx/html# touch f1 f2 f3
oot@nginx-deployment1-75f9c5858-2t297:/usr/share/nginx/html# ls
1  f2  f3  lost+found
oot@nginx-deployment1-75f9c5858-2t297:/usr/share/nginx/html# exit
exit
buntu@k8-master:~$ kubectl delete pod nginx-deployment1-75f9c5858-2t297
od "nginx-deployment1-75f9c5858-2t297" deleted
buntu@k8-master:~$ kubectl get pods
AME                                   READY   STATUS    RESTARTS   AGE
ginx-deployment1-75f9c5858-rr27s   1/1     Running   0          6m18s
ginx-deployment1-75f9c5858-vvff7   1/1     Running   0          4s
buntu@k8-master:~$ kubectl exec -it nginx-deployment1-75f9c5858-vvff7  -- bin/bash
oot@nginx-deployment1-75f9c5858-vvff7:/# cd usr/share/nginx/html
oot@nginx-deployment1-75f9c5858-vvff7:/usr/share/nginx/html# ls
1  f2  f3  lost+found
oot@nginx-deployment1-75f9c5858-vvff7:/usr/share/nginx/html#
```

Volumes (4) Info

Last updated less than a minute ago | Actions | Create volume

Saved filter sets: Choose filter set | Search | 1

Name	Volume ID	Type	Size	IOPS	Throughput	Snapshot ID	Created
–	vol-034e245a44c82eab6	gp2	1 GiB	100	-	-	2025/04/15 21:48 GMT+5:...
–	vol-0b8e6ee26d73250f4	gp3	8 GiB	3000	125	snap-00a5570...	2025/04/09 18:42 GMT+5:...
–	vol-04ba10de64037d0dd	gp3	8 GiB	3000	125	snap-00a5570...	2025/04/09 18:42 GMT+5:...
–	vol-03f204a1c91dde5a0	gp3	8 GiB	3000	125	snap-00a5570...	2025/04/09 18:42 GMT+5:...