# Configuring and Managing Kubernetes Storage and Scheduling

## CONFIGURING AND MANAGING STORAGE IN KUBERNETES

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# Course Overview

## Configuring and Managing Storage in Kubernetes

**Configuration as Data - Environment Variables, Secrets, and ConfigMaps**

**Managing and Controlling the Kubernetes Scheduler**

# Overview

Persistent Storage in Containers

Kubernetes Storage Objects

Storage Lifecycle

Using Storage in Kubernetes

# Persistent Storage and Containers

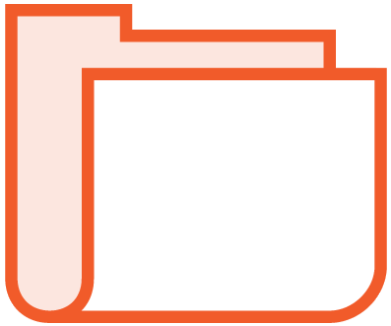
**Containers are ephemeral**

**A container's Writable Layer is deleted when the container is deleted**

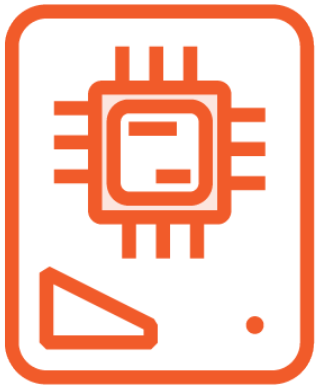
**When a Pod is deleted, its container(s) is deleted from the Node**


**How can we persist data across a Pod's lifecycle?**

# Storage API Objects in Kubernetes

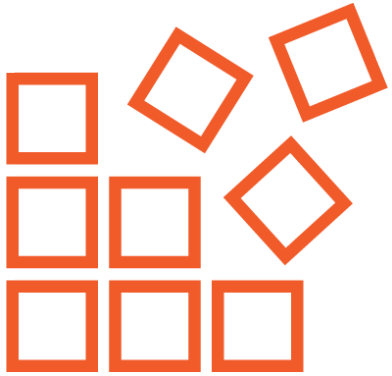


Volume



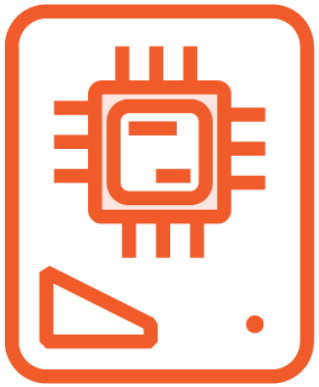
Persistent Volume

Persistent Volume Claim



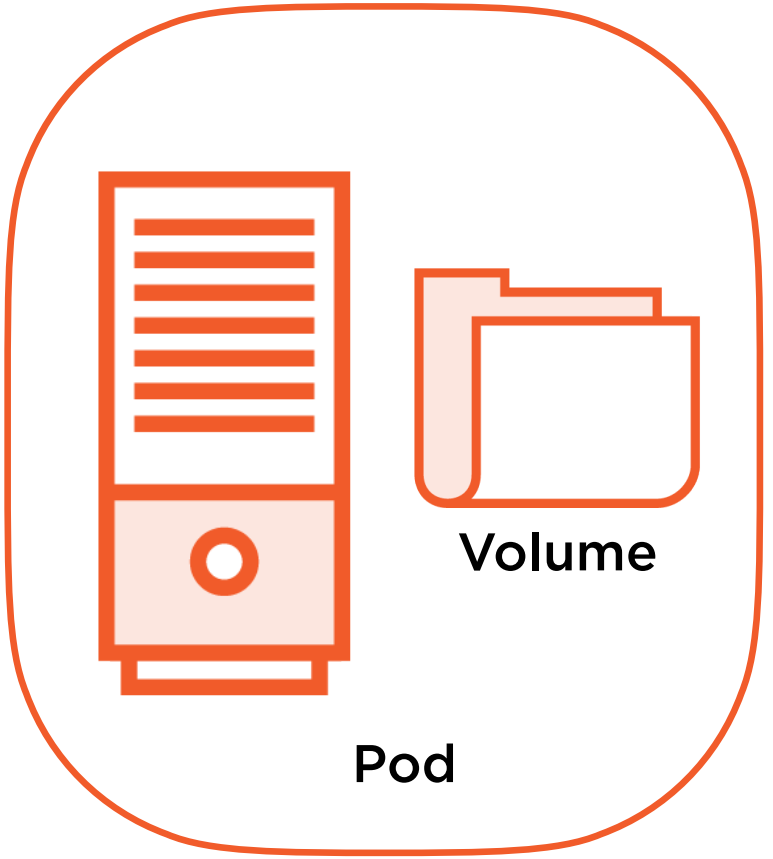
Storage Class

# Storage in Kubernetes

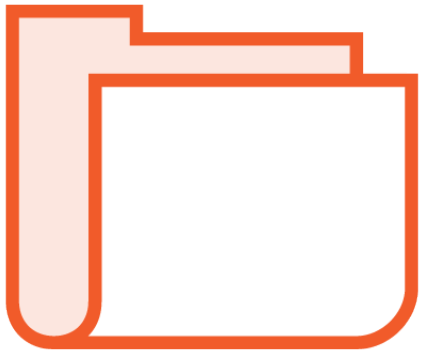


Persistent Volume

Persistent Volume Claim



# Volumes



Persistent storage deployed as part of the Pod spec

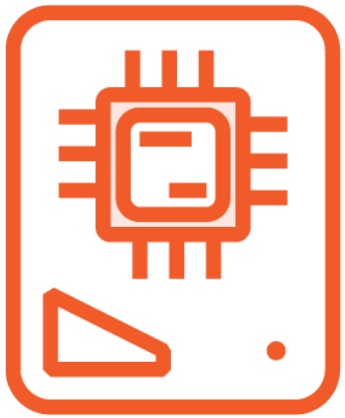
Implementation details for your storage

This can be challenging...

- Sharing code
- Same lifecycle as Pod

We can do better...

# Persistent Volumes



Administrator defined storage in the Cluster

Implementation details for your storage

Lifecycle independent of the Pod

Managed by the Kubelet

- Maps the storage in the Node
- Exposes PV as a mount inside the container

https://kubernetes.io/docs/concepts/storage/persistent-volumes/

# Types of Persistent Volumes

| Networked | Block | Cloud |
| --- | --- | --- |
| NFS | Fibre Channel | awsElasticBlockStore |
| azureFile | iSCSI | azureDisk |
| | | gcePersistentDisk |

https://kubernetes.io/docs/concepts/storage/persistent-volumes/#types-of-persistent-volumes

# Persistent Volumes Claims

**A request for storage by a user**

- **Size**
- **Access Mode**
- **Storage Class**

**Enable portability of your application configurations**

**The Cluster will map a PVC to a PV**

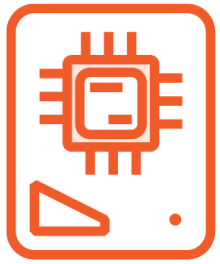
# Access Modes

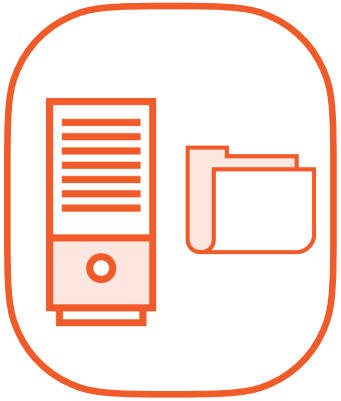
| ReadWriteOnce (RWO) | ReadWriteMany (RWX) | ReadOnlyMany (ROX) |
| --- | --- | --- |

Node level access, not Pod access

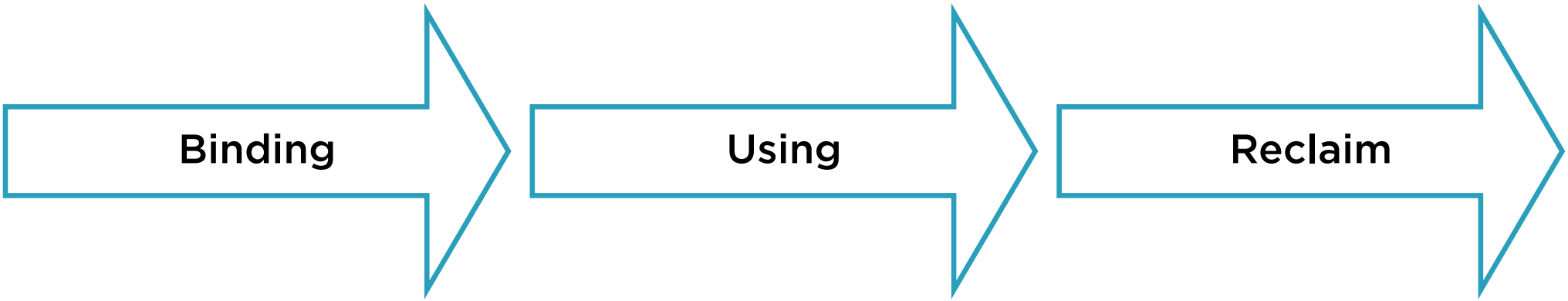
# Static Provisioning Workflow

| Create a `PersistentVolume` | Create a `PersistentVolumeClaim` | Define `Volume` in Pod Spec |
| --- | --- | --- |





# Storage Lifecycle




PVC Created

Control Loop

Matches PVC->PV

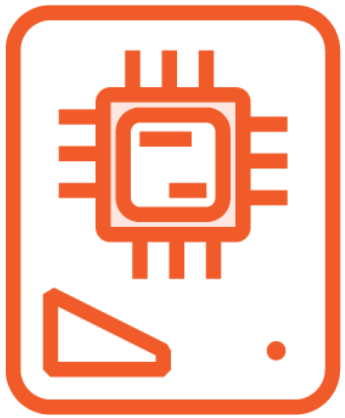
Pod's Lifetime

PVC Deleted

`Delete (default)`

`Retain`

# Defining a Persistent Volume



**type { nfs, fc, azureDisk, ... }**

**capacity**

**accessModes**

**persistentVolumeReclaimPolicy**

**Labels**

# Defining a Persistent Volume

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: pv-nfs-data
spec:
  capacity:
    storage: 10Gi
  accessModes:
    - ReadWriteMany
 nfs:
    server: 172.16.94.5
    path: "/export/volumes/pod"
```

# Defining a Persistent Volume Claim

**accessModes**

**resources**

**storageClassName**

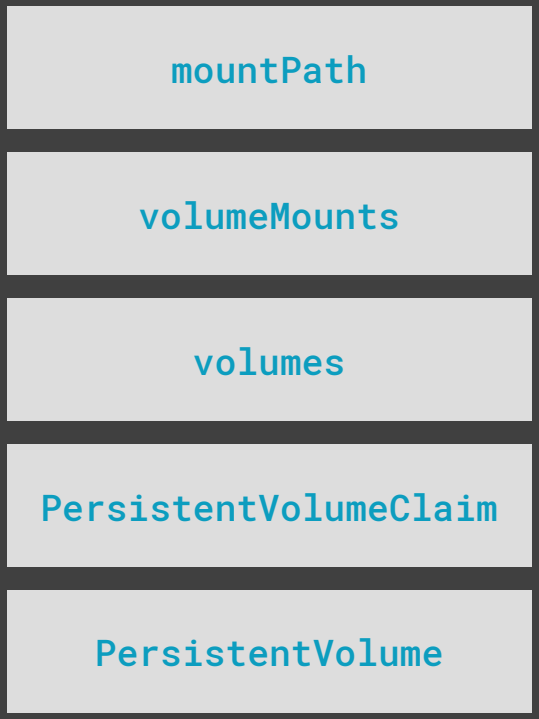
**selector**

# Defining a Persistent Volume Claim

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: pvc-nfs-data
spec:
  accessModes:
    - ReadWriteMany
 resources:
    requests:
      storage: 10Gi
```

# Using Persistent Volumes in Pods

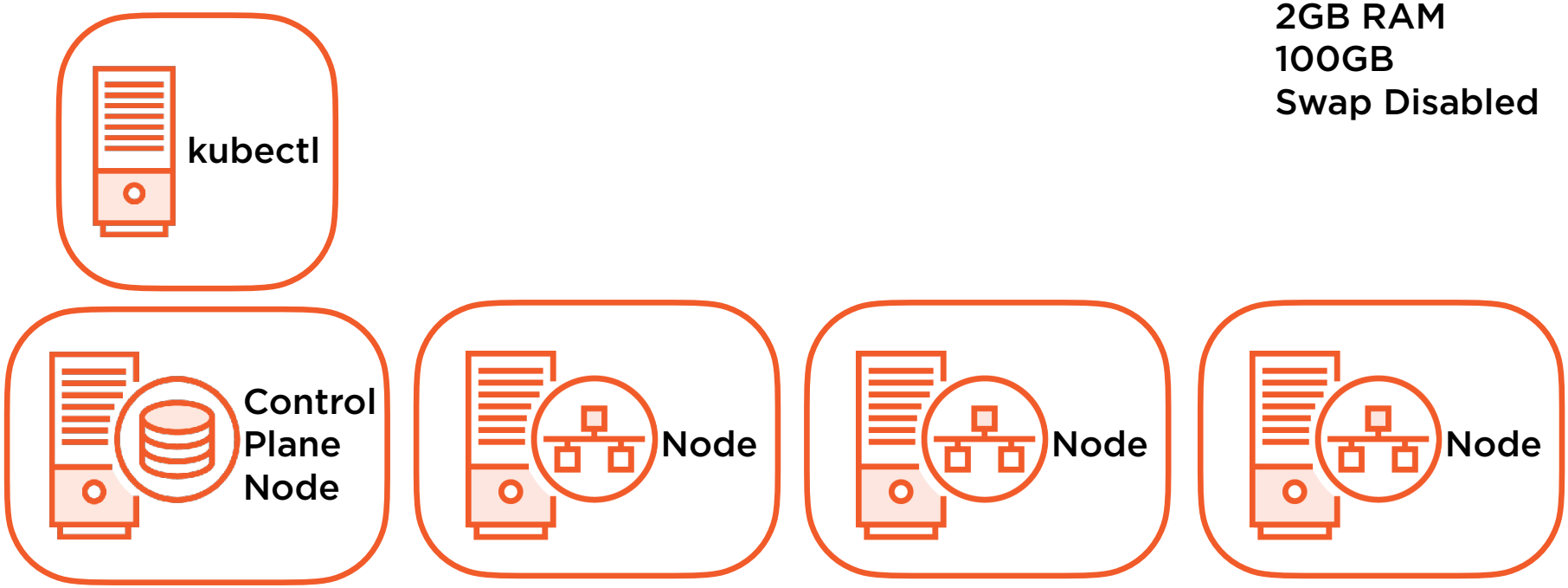
```
...
spec:
 volumes:
  - name: webcontent
    persistentVolumeClaim:
      claimName: pvc-nfs-data
 containers:
 - name: nginx
   ...
   volumeMounts:
   - name: webcontent
     mountPath: "/usr/share/nginx/html/web-app"
```



Hostnames set
Host file on each

# Lab Environment

Ubuntu 18.0.4
VMware Fusion VMs
2vCPU
2GB RAM
100GB
Swap Disabled




| c1-cp1 | c1-node1 | c1-node2 | c1-node3 |
|---|---|---|---|
| 172.16.94.10 | 172.16.94.11 | 172.16.94.12 | 172.16.94.13 |

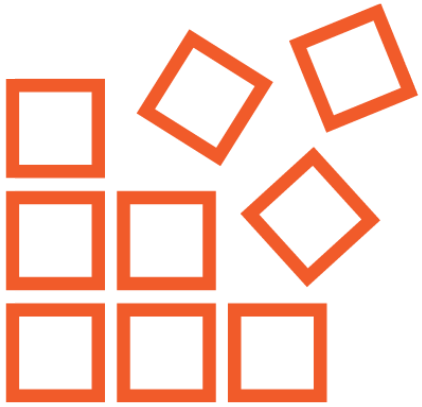
# Demo

Storage Server Overview - NFS

Static Provisioning Persistent Volumes

Storage Lifecycle and Reclaim Policy

# Storage Class



**Define tiers/classes of storage**

**Enables Dynamic Provisioning**

**Define infrastructure specific parameters**

**Reclaim Policy**

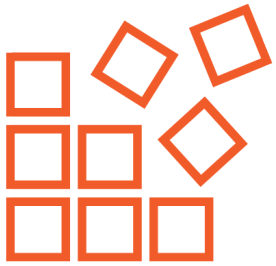
# Dynamic Provisioning Workflow

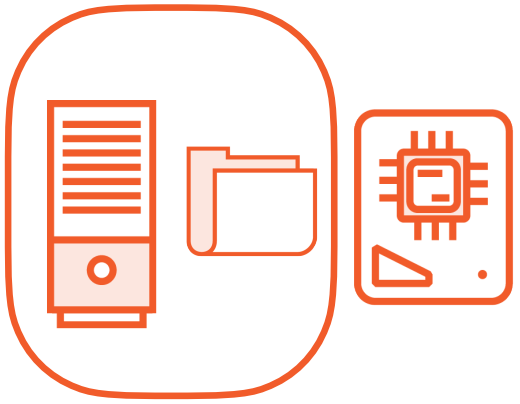
**Create a** `StorageClass`

**Create a** `PersistentVolumeClaim`

**Define** `Volume` **in Pod Spec**

**Creates a** `PersistentVolume`





# Defining a StorageClass

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: managed-premium
parameters:
  kind: Managed
  storageaccounttype: Premium_LRS
provisioner: kubernetes.io/azure-disk
```

# Dynamic Provisioning

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: pvc-azure-managed
spec:
  accessModes:
  - ReadWriteOnce
  storageClassName: managed-premium
  resources:
    requests:
      storage: 10Gi
```

# Demo

Dynamic Provisioning in the Cloud

Defining a custom `StorageClass`

# Review

Persistent Storage in Containers

Kubernetes Storage Objects

Storage Lifecycle

Using Storage in Kubernetes

# What's Next!

## Configuration as Data - Environment Variables, Secrets, and ConfigMaps