Storage and Persistence

Volumes and Claims. Configuration Maps and Secrets. Stateful Sets

kubernetes

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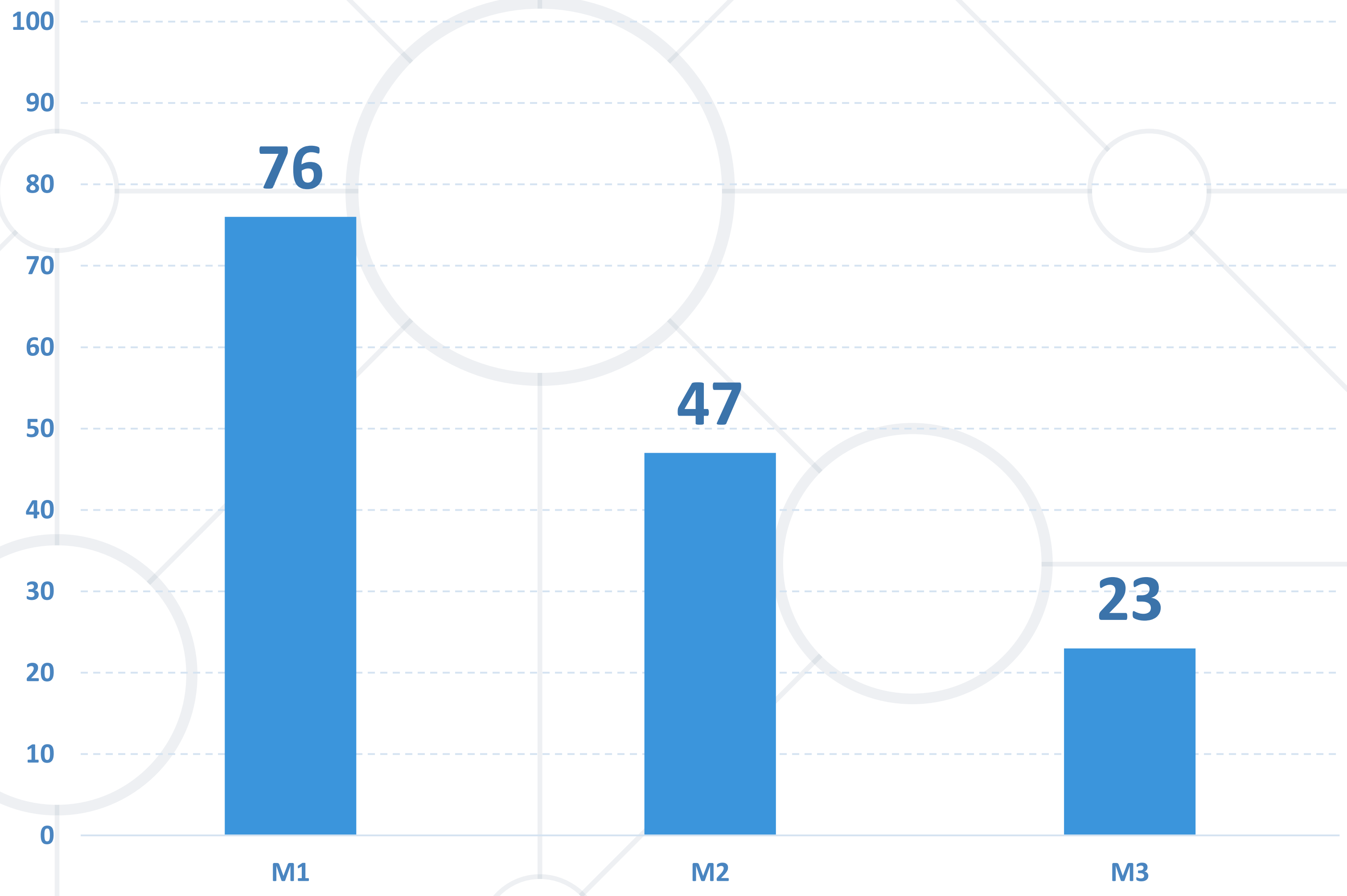
Homework Progress



Submit M3
until 23:59:59
on 06.11.2023

Submit M4
until 23:59:59
on 13.11.2023

Previous Module (M3)

Quick overview

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This Module (M4)

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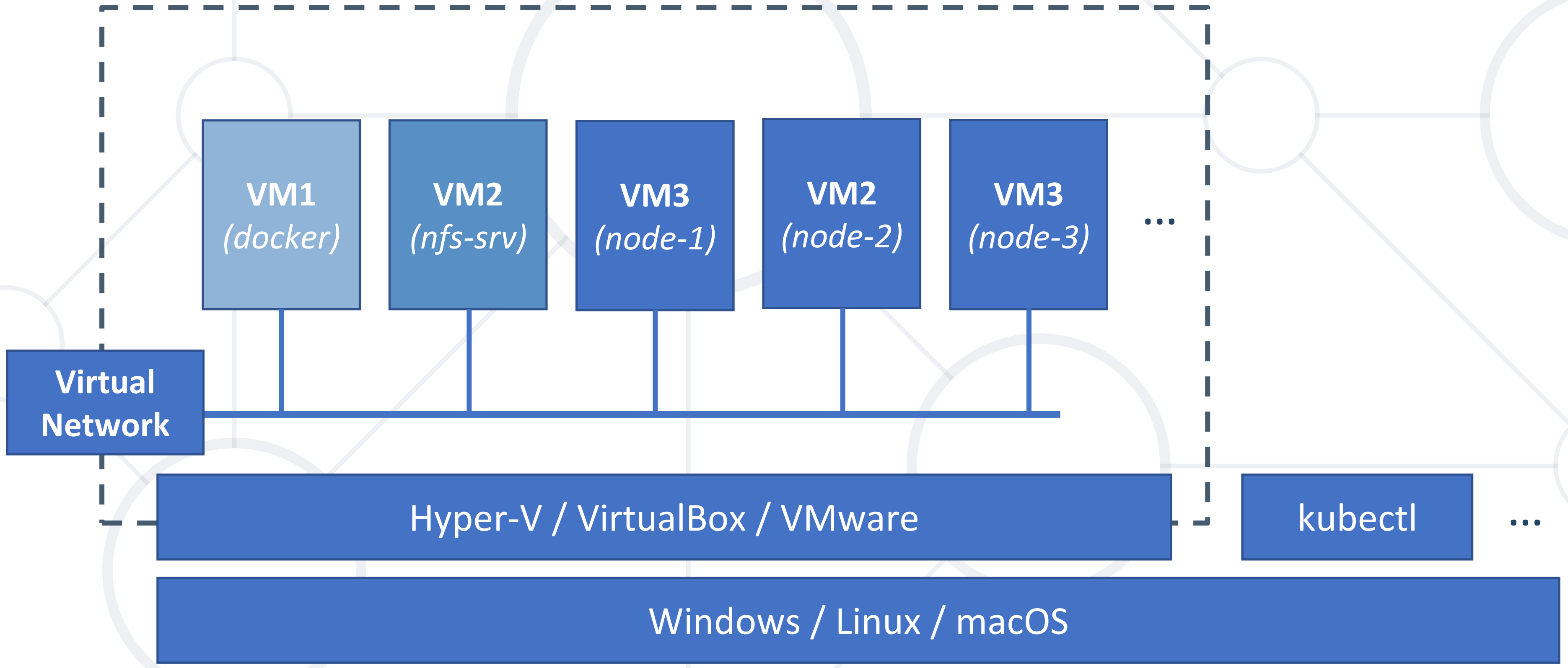
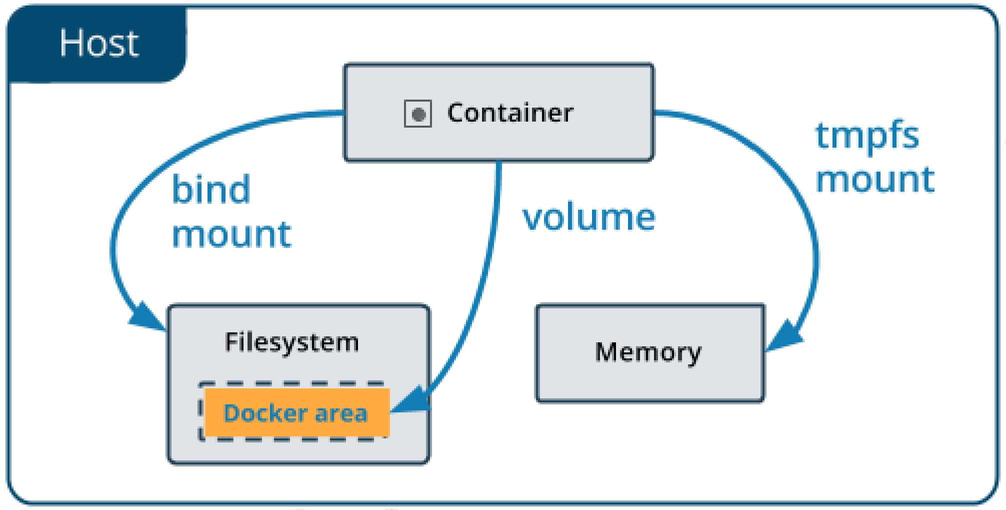
Lab Infrastructure



(Persistent) Volumes and Claims

The Docker Way

- **Bind Mounts** are dependent on the OS and file system structure
- **Volumes** are managed by Docker
- **tmpfs mount** is for non-persistent state data
- **--volume** (**-v**) is simpler, and **--mount** is more explicit and verbose



https://docs.docker.com/storage/volumes/

Kubernetes Storage Options *

- Volumes
  - Ephemeral
  - Persistent
- Persistent Volumes and Claims
- Storage Classes

https://kubernetes.io/docs/concepts/storage/

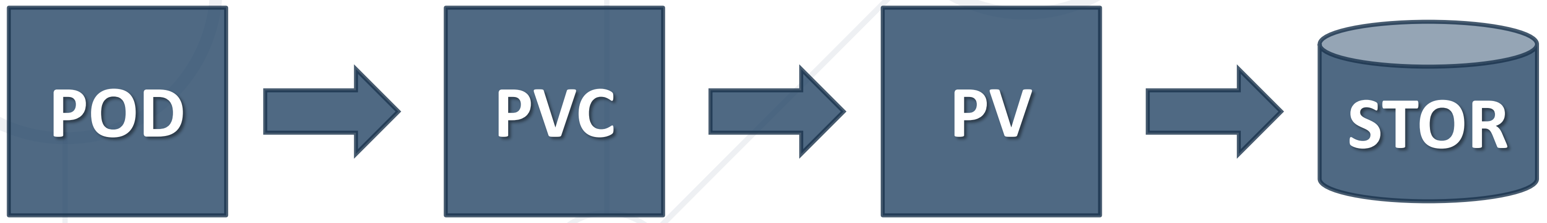
Volumes

- Volumes solve the problem with the **loss of data** when a container is restarted
- In addition, they provide a way to **share data** between containers in a pod
- Support various on-premise options like **nfs**, **cephfs**, **fc**, **iscsi**, etc.
- Support cloud options like **AWS EBS**, **Azure Data Disk**, **GCE PD**, etc.
- They are **declared** (**volumes:**) and **mounted** (**volumeMounts:**) in pod's manifests

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

Persistent Volumes and Claims

- Storage administration is a separate activity by itself
- Persistent volumes provide an API that **abstracts** the storage
- **PersistentVolume** (**PV**) is a piece of storage in the cluster that has been provisioned either by the administrator or dynamically
- PVs have an independent lifecycle of the Pods that may use them
- **PersistentVolumeClaim** (**PVC**) is a request for storage by a user



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

PV and PVC Lifecycle

- **Provisioning** can be done either static or dynamic
- **Binding** is the process of **matching** and **attaching** a **PVC** to **PV**. This is done on a **set of criteria**. It is **ono-to-one mapping**
- Pods are **using** PVCs as volumes

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

PV and PVC Lifecycle

- When done, PVCs can be deleted. This will trigger the reclaim policy which may be
  - **Retain** allows for manual reclamation of the resource
  - **Delete** removes both the PV object from Kubernetes, as well as the associated storage asset in the external infrastructure
  - **Recycle** performs a basic scrub on the volume and makes it available again (deprecated)

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

Storage Classes

- Used to define types or **profiles** of available storage
- Can be used for **automated volume provision**
- Have three main components
  - **Provisioner** determines the volume plugin for PVs provisioning
  - **Parameters** control provisioner's behavior
  - **Reclaim** policy is inherited by the PVs that will be created

https://kubernetes.io/docs/concepts/storage/storage-classes/

Practice

Live Exercise in Class (Lab)

Configuration Maps and Secrets

Overview

- We may need to inject data into applications
- Effectively, we must pass the data to the containers
- Container runtime offers this via environment variables
- Kubernetes offers
  - Environment variables
  - Configuration Maps
  - Secrets

https://kubernetes.io/docs/tasks/inject-data-application/

Environment Variables

- Key-value pairs used to pass data to the containers inside a pod
- Created in the manifest via **env** or **envFrom** blocks
- **Override** any environment variables in the container
- They may **reference** each other but then their **definition order is important**
- Reference is done via the **$(REFVAR)** construct

https://kubernetes.io/docs/tasks/inject-data-application/define-environment-variable-container/

Configuration Maps

- Used to store **non-confidential data** in key-value pairs
- Pods can consume them as **environment variables**, **command-line arguments**, or as **configuration files in volumes**
- We use them to **separate configuration data** from **application code**
- They are not designed to store large chucks of data (**max 1 MiB**)
- The name of a **ConfigMap** must be a **valid DNS subdomain** name

https://kubernetes.io/docs/concepts/configuration/configmap/

Secrets

- Contain a small amount of sensitive data such as a **password**, a **token**, or a **key**
- This way confidential data is separated from the application code
- Similar to **ConfigMaps** but are specifically intended to hold confidential data
- Consumed via **files in a volume**, **environment variables**, or by the kubelet while pulling images for the pod (**imagePullSecrets**)
- Secrets can be **opaque**, **tls**, **token**, **service-account-token**, etc.

https://kubernetes.io/docs/concepts/configuration/secret/

Practice

Live Exercise in Class (Lab)

Stateful Sets

Stateful Sets

- Used to manage **stateful applications**
- Manage the deployment of a **set of Pods**
- Pods are with identical container specifications just **like** with **Deployment** and **ReplicaSet**
- The main **difference** here is that the Pods have **persistent identifiers** that are **maintained across rescheduling**
- **Storage volumes** can be used as part of the solution for providing persistence

https://kubernetes.io/docs/concepts/workloads/controllers/statefulset/

Stateful Sets Added Value

- Stable and unique network identifiers
- Stable and persistent storage
- Ordered graceful deployment and scaling
- Ordered and automated rolling updates

** Stable = persistence across pod (re)scheduling*

** Ordered = when scaling up it is done from 0 to N and when scaling down it is done from N to 0*

https://kubernetes.io/docs/concepts/workloads/controllers/statefulset/

Stateful Sets Limitations

- Storage for a Pod must be provisioned **upfront** either automatically or by an administrator
- Deleting or scaling down **doesn't delete the associated volumes**
- **Headless service** is required for the network identity of the pods
- StatefulSet deletion **doesn't guarantee the pods termination order**. If required, first we must scale it down to 0
- Rolling updates (with OrderedReady policy) may get broken and then a manual intervention may be required

https://kubernetes.io/docs/concepts/workloads/controllers/statefulset/

Practice

Live Exercise in Class (Lab)

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