Docker for Web Developers

WHY USE DOCKER AS A DEVELOPER?

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Placeholder

Promo Video Demo
of Parts of Course Goes Here

I'll talk over the video
Created after the course is done

Course Agenda

- Why Use Docker as a Developer?
- Setting Up Your Dev Environment with Docker Toolbox
- Using Docker Client in Your Dev Environment
- Hooking Your Source Code Into a Container
- Linking Docker Containers
- Managing Multiple Containers with Docker Compose
- Deploying Your Containers to Azure
- Reviewing the Case for Docker

Why Use Docker as a Developer?

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Module Agenda

What is Docker?

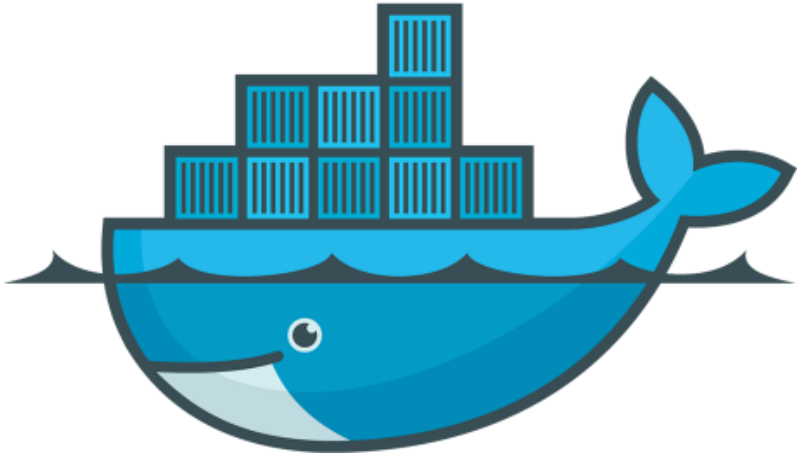
Docker Benefits
(for Web Developers)

Docker Tools

Docker in Action

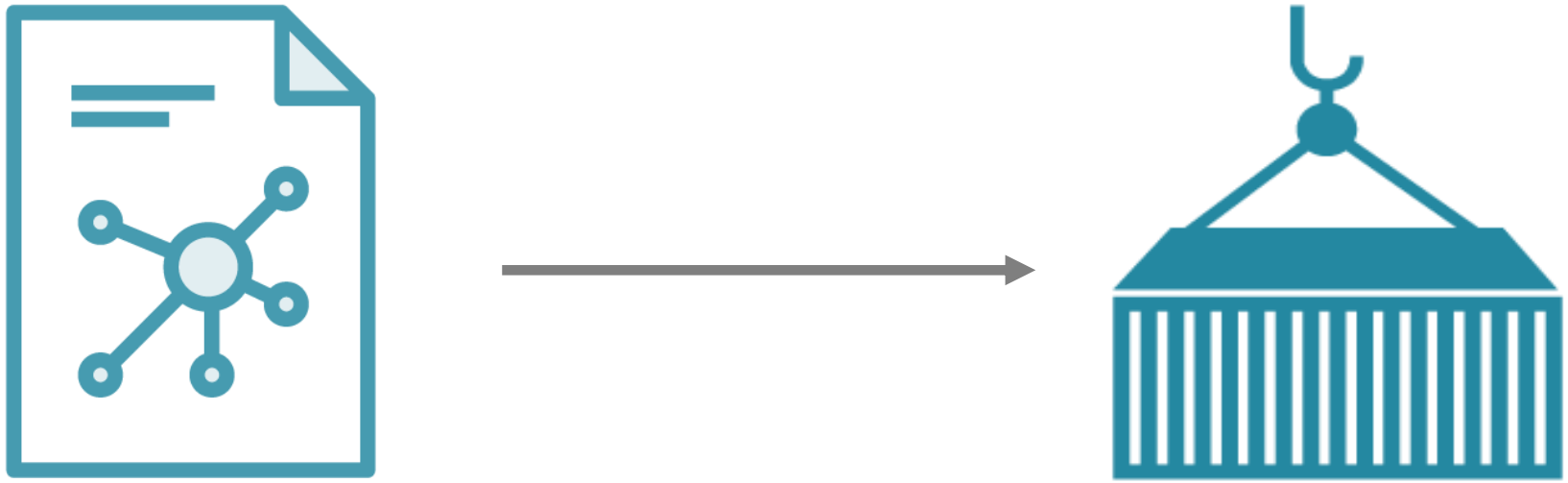
What is Docker?

What is Docker?



- Lightweight, open, secure platform
- Simplify building, shipping, running apps
- Shipping container system for code
- Runs natively on Linux or Windows Server
- Runs on Windows or Mac Development machines (with a virtual machine)
- Relies on "images" and "containers"

The Role of Images and Containers



Docker Image

Example: Ubuntu with Node.js and Application Code

Docker Container

Created by using an image. Runs your application.

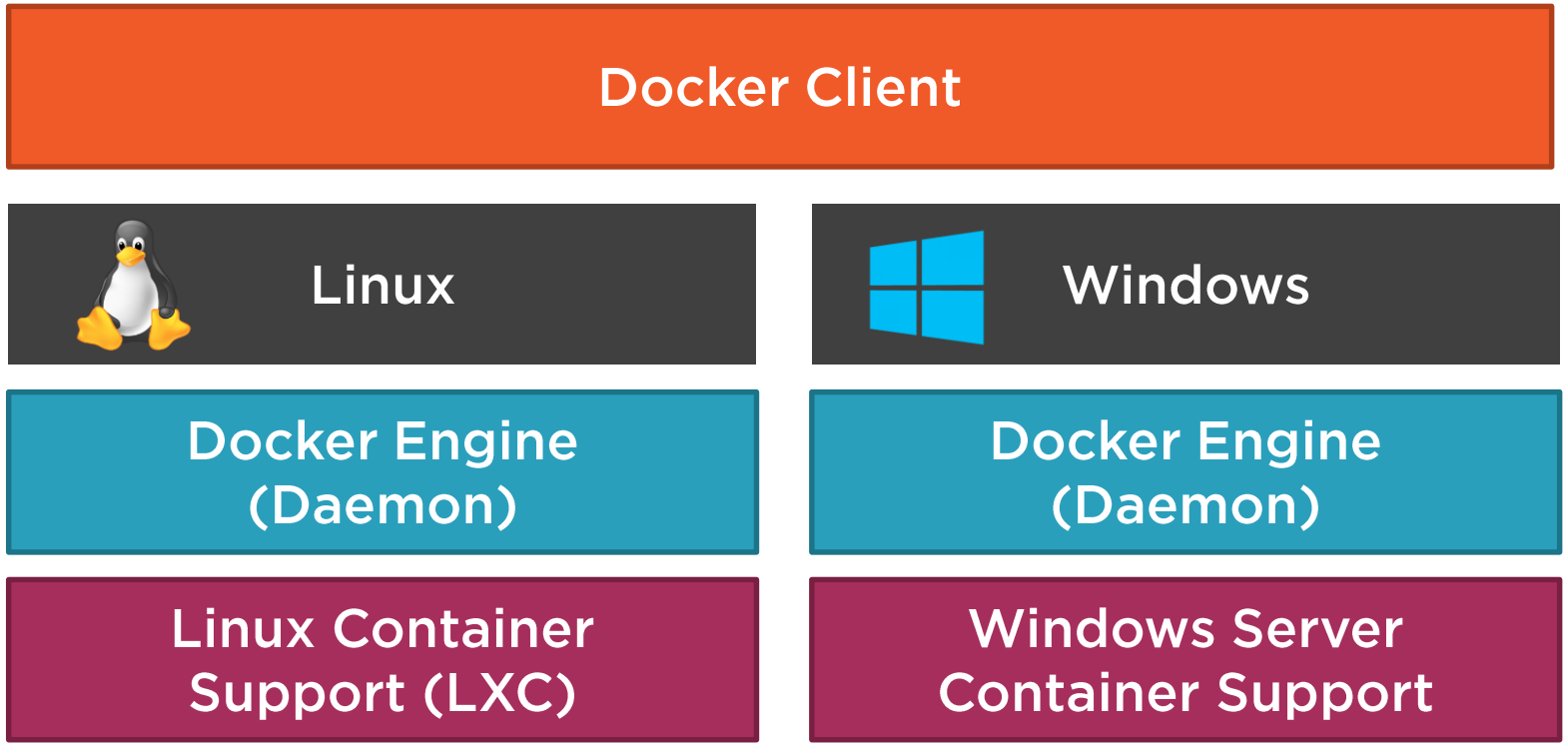
Image

A **read-only template** composed of layered filesystems used to share common files and create Docker container instances.

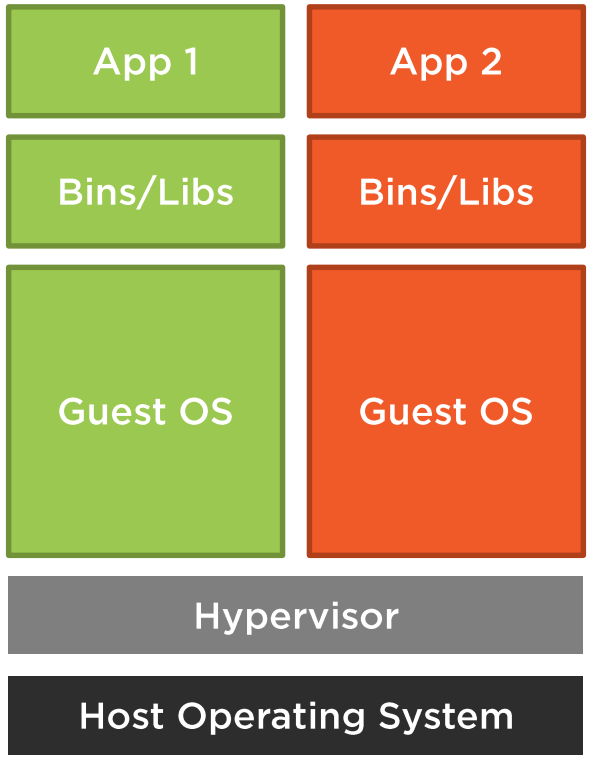
Container

An isolated and secured shipping container created from an image that can be run, started, stopped, moved and deleted.

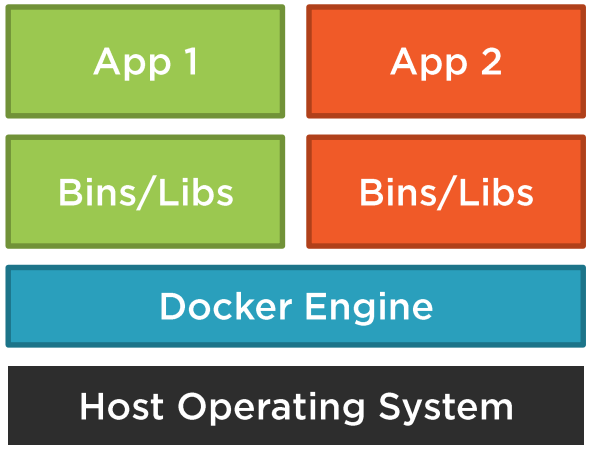
Where Does Docker Run?



Docker Containers Versus Virtual Machines



Virtual Machines



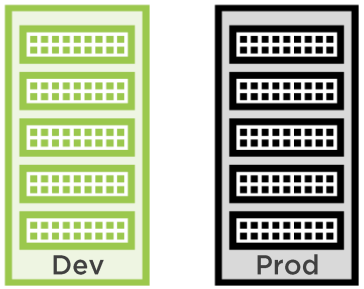
Docker Containers

Docker Benefits (for Web Developers)

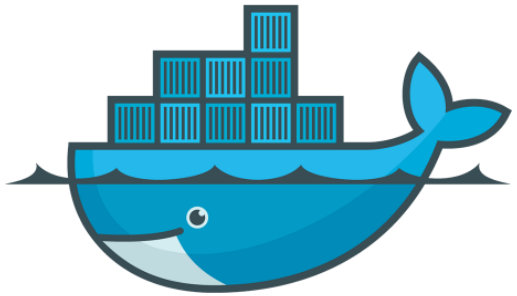
Docker Benefits
(for Web Developers)

Accelerate Developer Onboarding

Eliminate App Conflicts

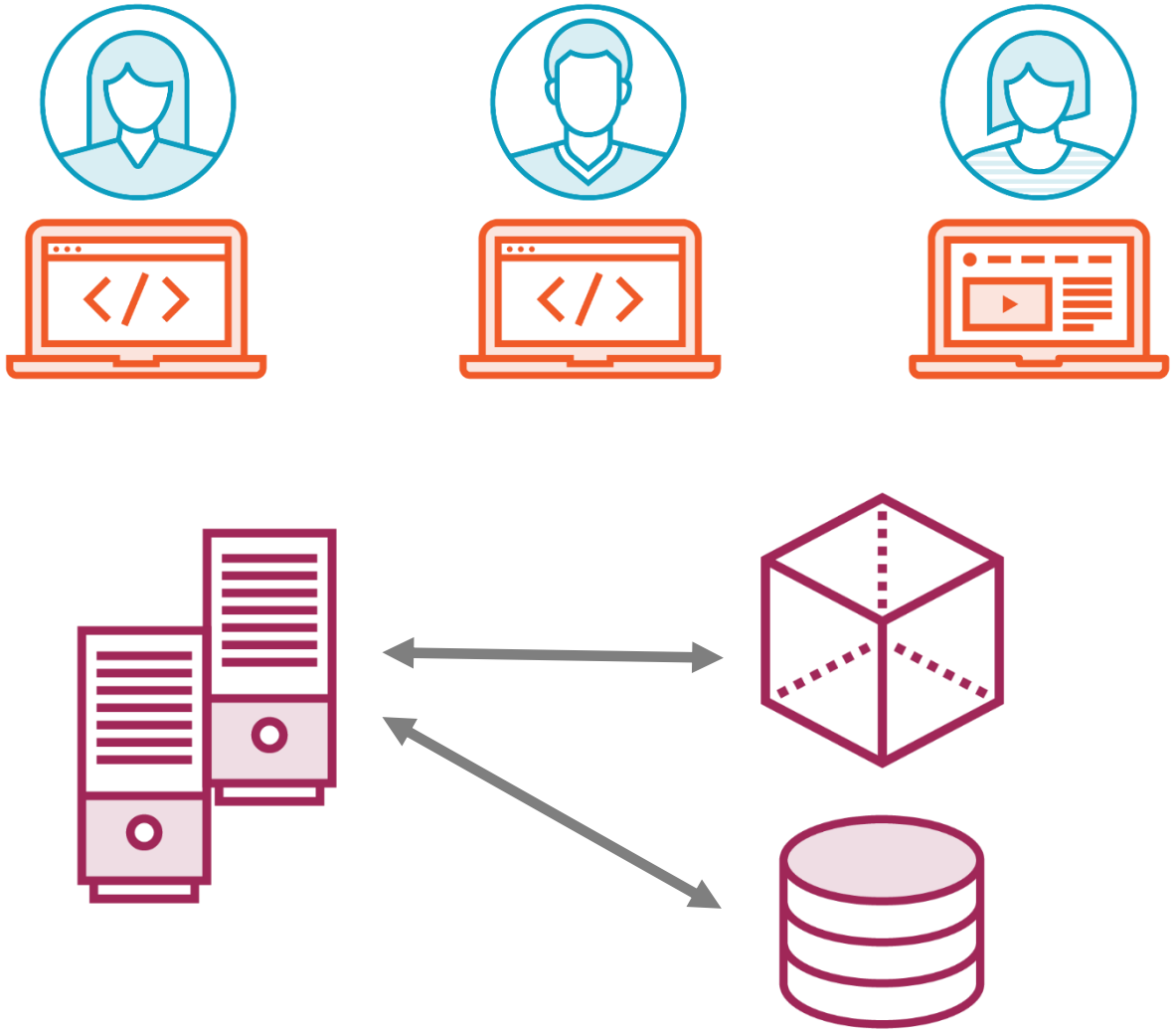


Environment Consistency

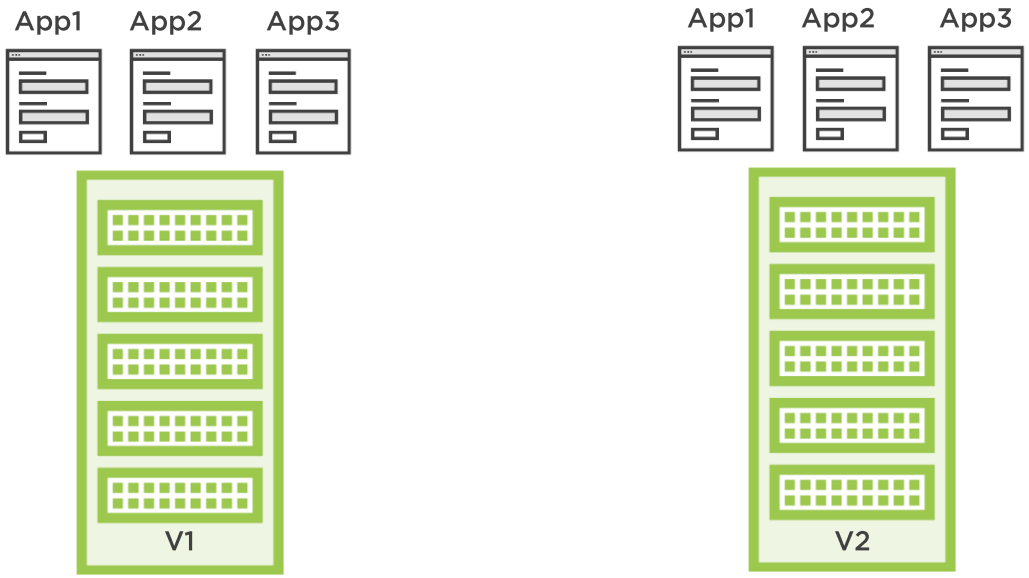


Ship Software Faster

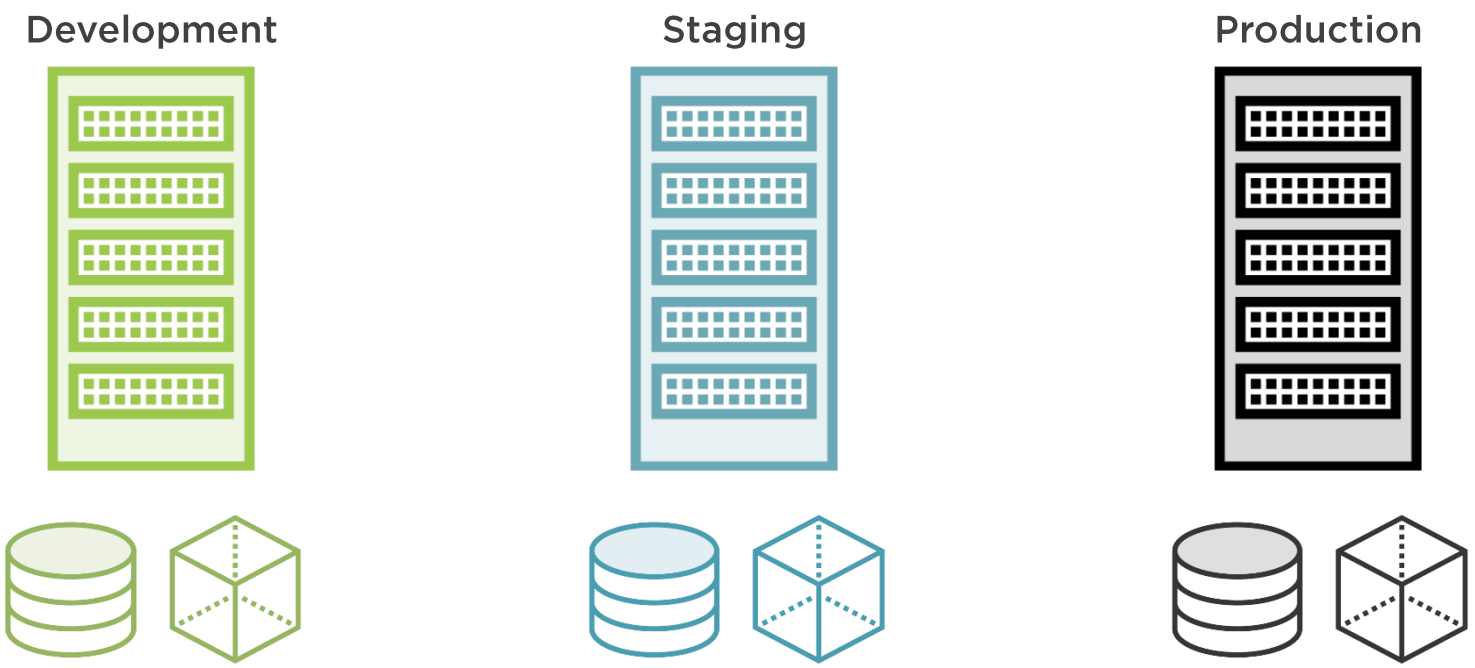
Accelerate Developer Onboarding



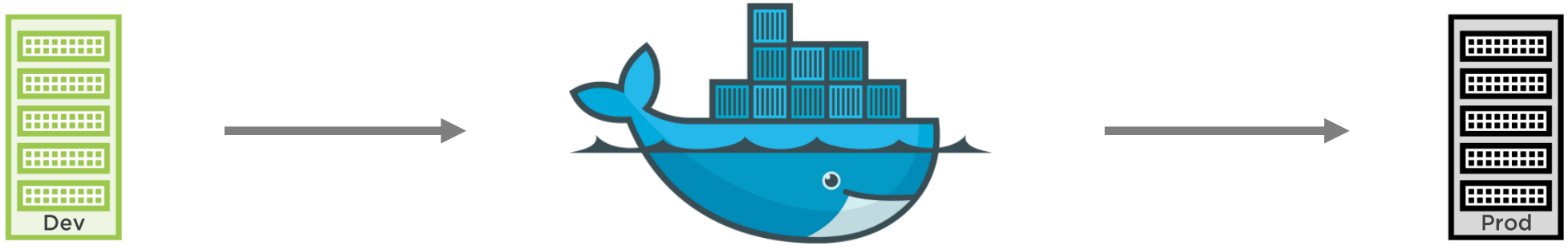
Eliminate App Conflicts



Environment Consistency



Ship Software Faster



Docker Tools

Docker Toolbox

Legacy option for Windows 7/8

Provides image and container tools

Virtual machine

https://www.docker.com/docker-toolbox

Docker Toolbox Tools

- Docker Client
- Docker Machine
- Docker Compose
- Docker Kitematic
- VirtualBox

Docker Desktop

Docker Desktop (Windows 10 Pro+ or Mac)

Provides image and container tools

Using Hyper-V/Hyperkit to run VMs

Works on Windows, Mac, Linux (Docker Engine)

https://www.docker.com/get-started

Docker Desktop Tools

Docker Client

Docker Compose

Docker Kitematic

Docker Toolbox vs. Docker Desktop

Docker Toolbox	Docker Desktop
Windows 7 or 8	Windows 10+ Pro or Mac
Uses VirtualBox	Hyper-V/Hyperkit
Will use Docker Machine	

Docker in Action

Summary

Docker simplifies building, shipping and running apps

Runs natively on Linux and Windows Server

Docker is NOT the same as using Virtual Machines

Key benefits to Web Developers:

- Accelerate developer onboarding
- Simplify working with multiple apps
- Consistency between environments
- Ship faster!

Setting up Your Docker Environment

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Module Agenda

Installing Docker on Mac

Installing Docker on Windows

Getting Started with Docker Kitematic

Docker Kitematic in Action

Installing Docker on Mac

Installing Docker on Windows

Docker on Windows

Windows 7/8/
10 Home

Install
Docker Toolbox

Windows 10+ Pro

Install
Docker Desktop

Getting Started with Docker Kitematic

Docker Kitematic Overview

GUI used to provision VMs and work with Images and Containers

Visually Search for Docker images

Create, Run and Manage Containers

Docker Kitematic in Action

Summary

Docker Toolbox runs on Windows 7/8 or Windows 10 Home

Docker Desktop runs on Mac or Windows 10 Pro or higher

Docker Kitematic provides a visual way to work with images and containers

Using Docker Tools

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Docker Toolbox
Docker Desktop

Docker Client

Docker Compose

Docker Kitematic

Docker Machine (Docker Toolbox Only)

VirtualBox (Docker Toolbox Only)

Module Agenda

- Getting Started with Docker Machine
- Docker Machine in Action
- Getting Started with Docker Client
- Docker Client in Action
- Docker Commands Review

Getting Started with Docker Machine

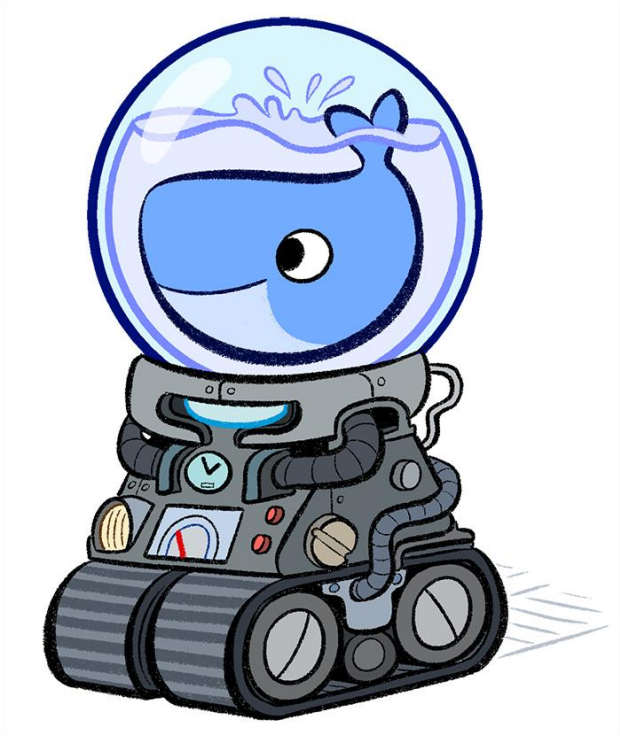
Docker Machine Overview

Create and Manage Local Machines

Create and Manage Cloud Machines

Configure Docker Client to talk to Machines

Key Docker Machine Commands



docker-machine ls

docker-machine start [machine name]

docker-machine stop [machine name]

docker-machine env [machine name]

docker-machine ip [machine name]

Docker Machine in Action (Mac)

Docker Machine in Action (Windows)

Getting Started with Docker Client

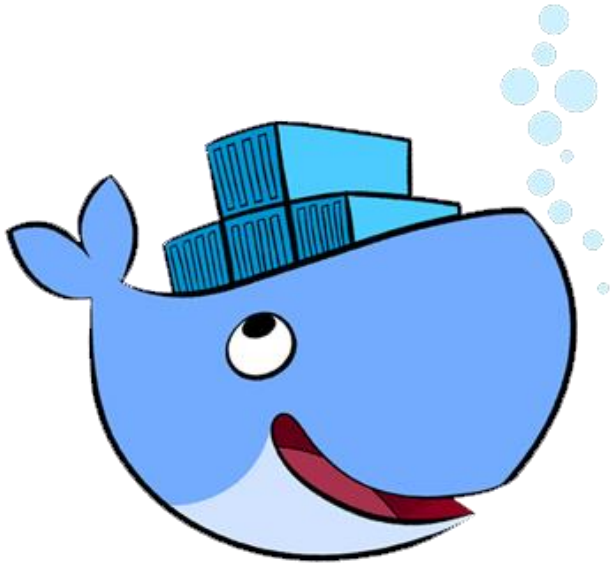
Docker Client Overview

Interact with Docker Engine

Build and Manage Images

Run and Manage Containers

Key Docker Client Commands



docker pull [image name]

docker run [image name]

docker images

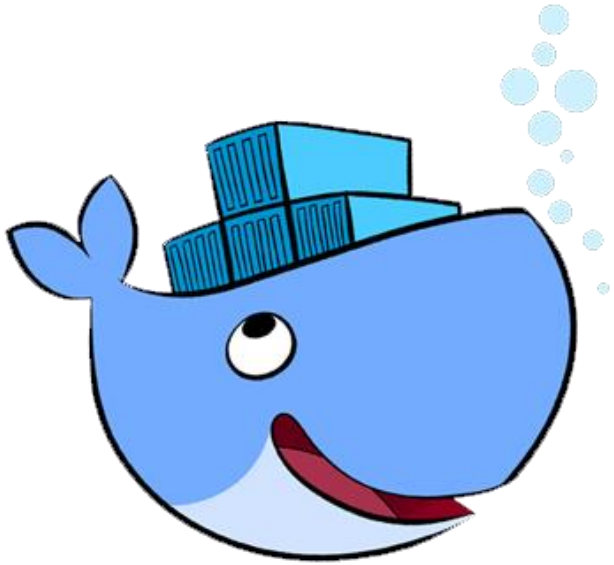
docker ps

Docker Client in Action (Mac)

Docker Client in Action (Windows)

Docker Commands Review

Key Docker Client Image Commands

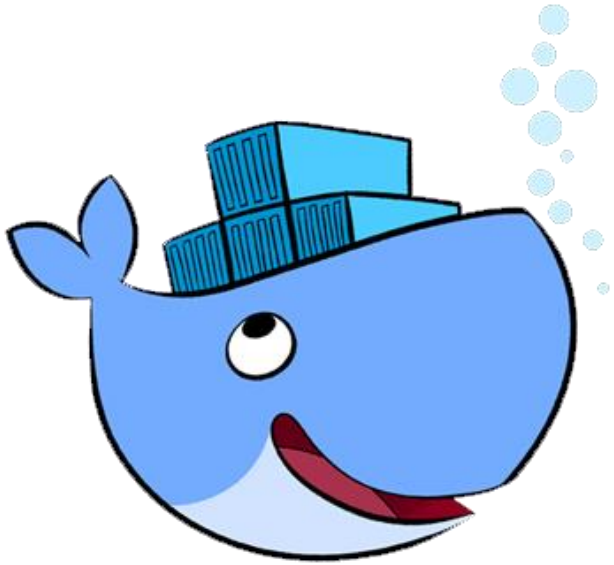


docker pull [image name]

docker images

docker rmi [image ID]

Key Docker Client Container Commands



```
docker run [image name]

docker ps –a

docker rm [container ID]
```

Summary

Docker Machine creates and manages machines (Docker Toolbox only)

Docker Client manages images and containers

Hooking Your Source Code into a Container

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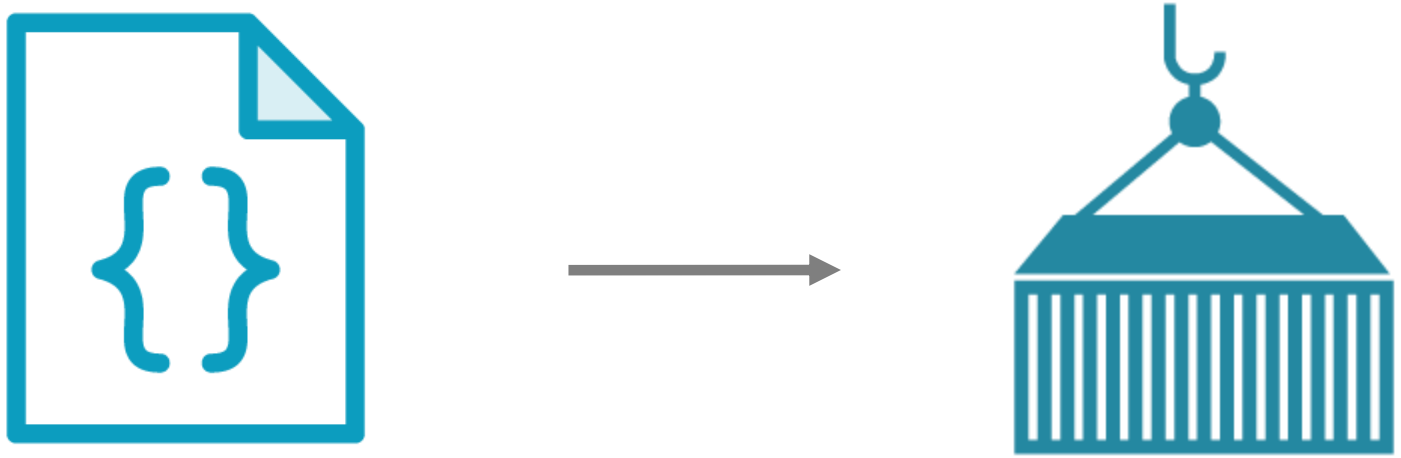
Module Agenda

- The Layered File System
- Containers and Volumes
- Source Code, Volumes and Containers
- Hooking a Container Volume to Source Code
- Removing Containers and Volumes

Question

How do you get source code into a container?



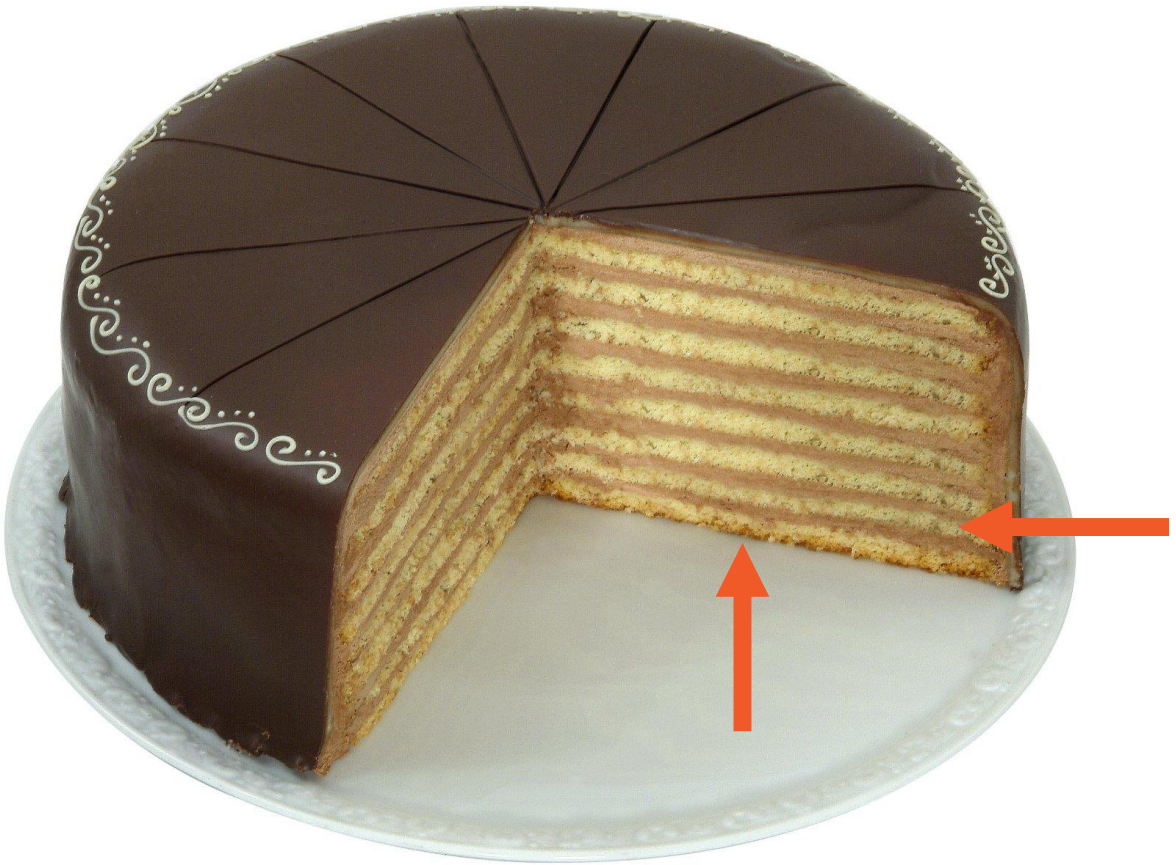
Answer

1. Create a container volume that points to the source code.

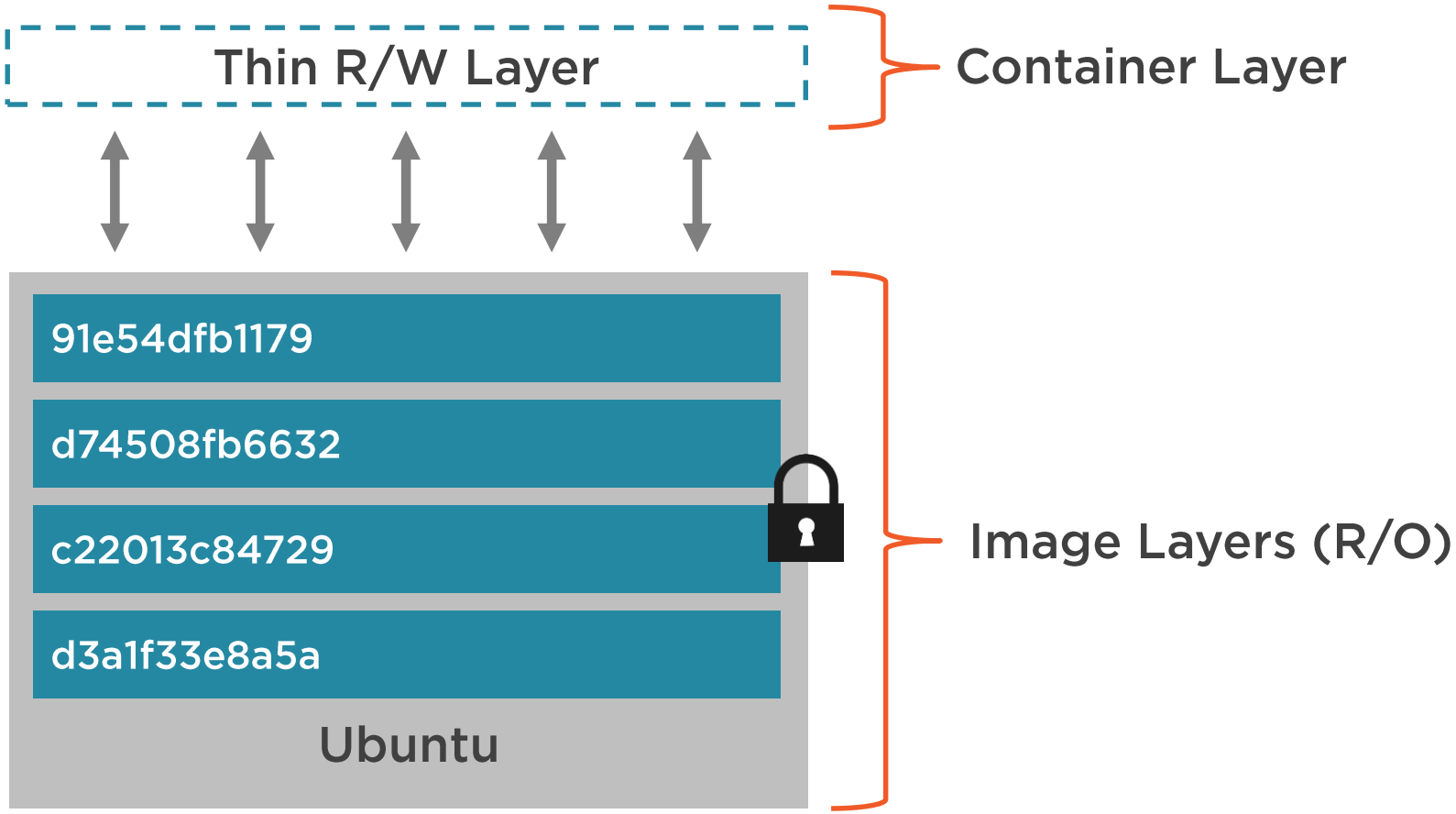
2. Add your source code into a custom image that is used to create a container.

The Layered File System

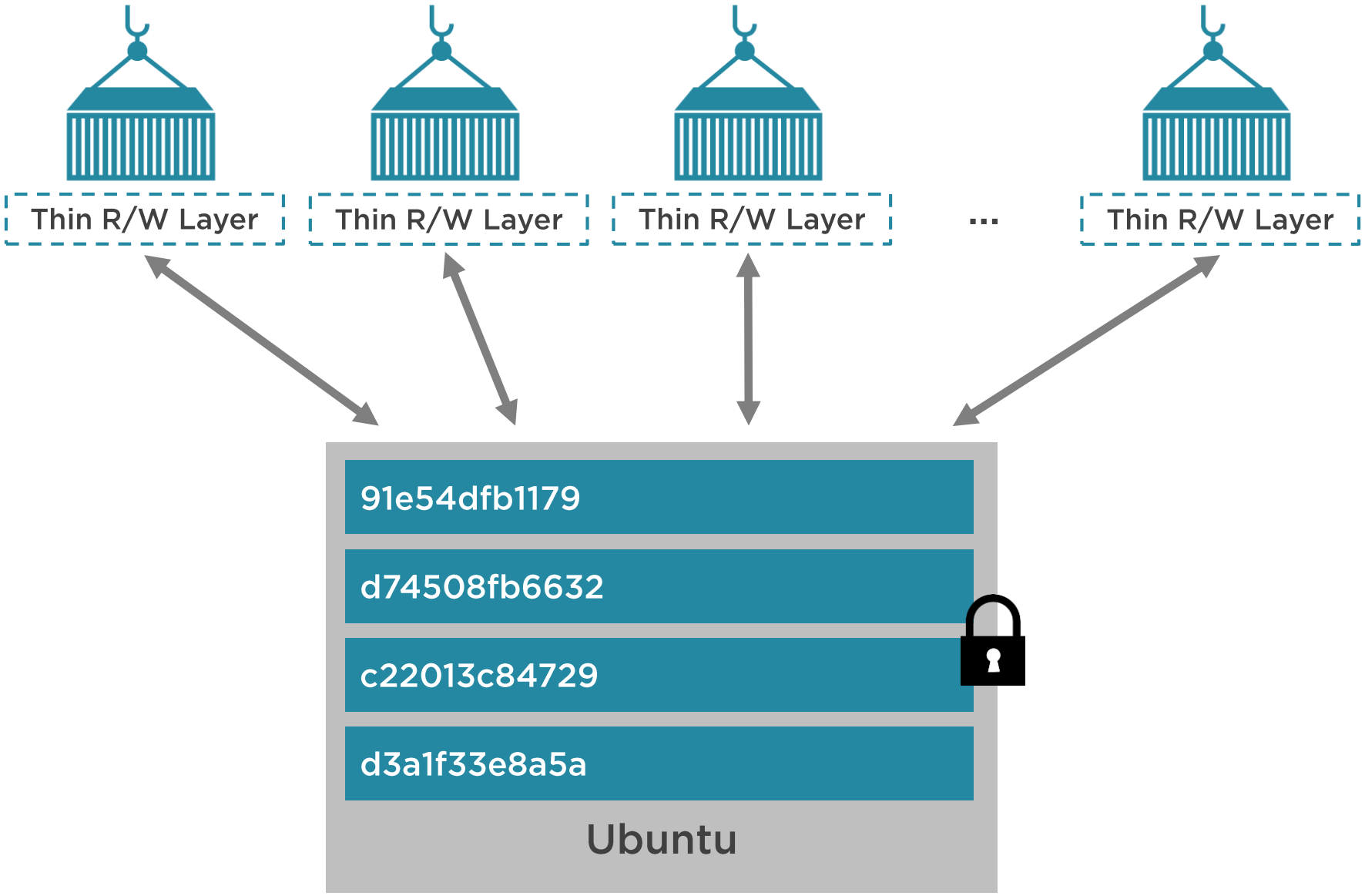
Layers (from a dessert perspective)



Images, Containers and File Layers

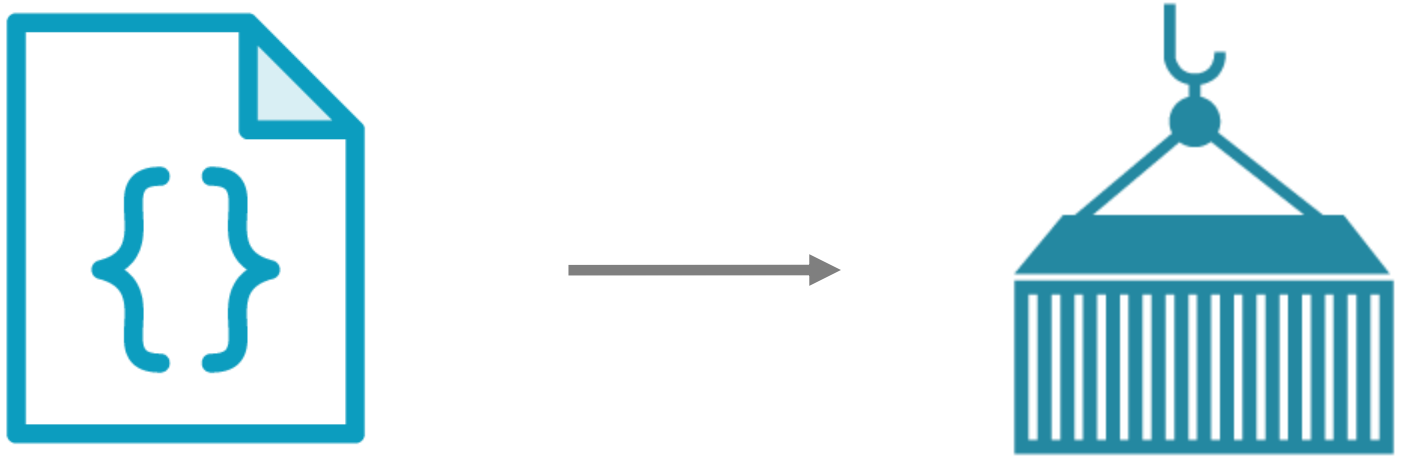


Containers Can Share Image Layers



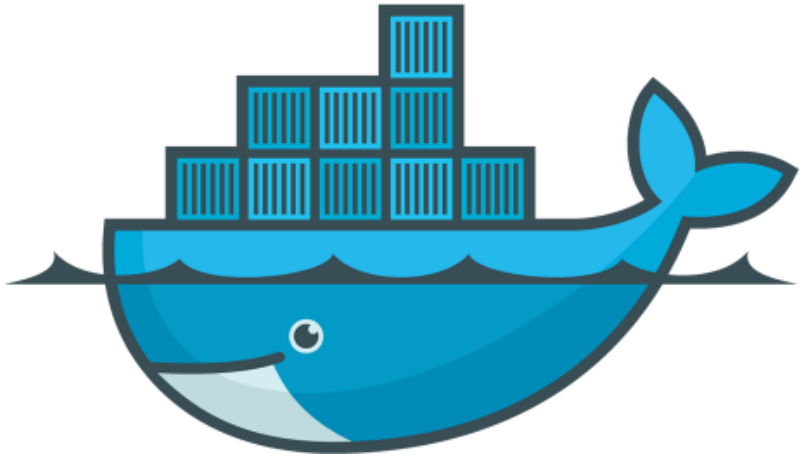
Question

How do you get source code into a container?



Containers and Volumes

Docker Volumes



What is a Volume?

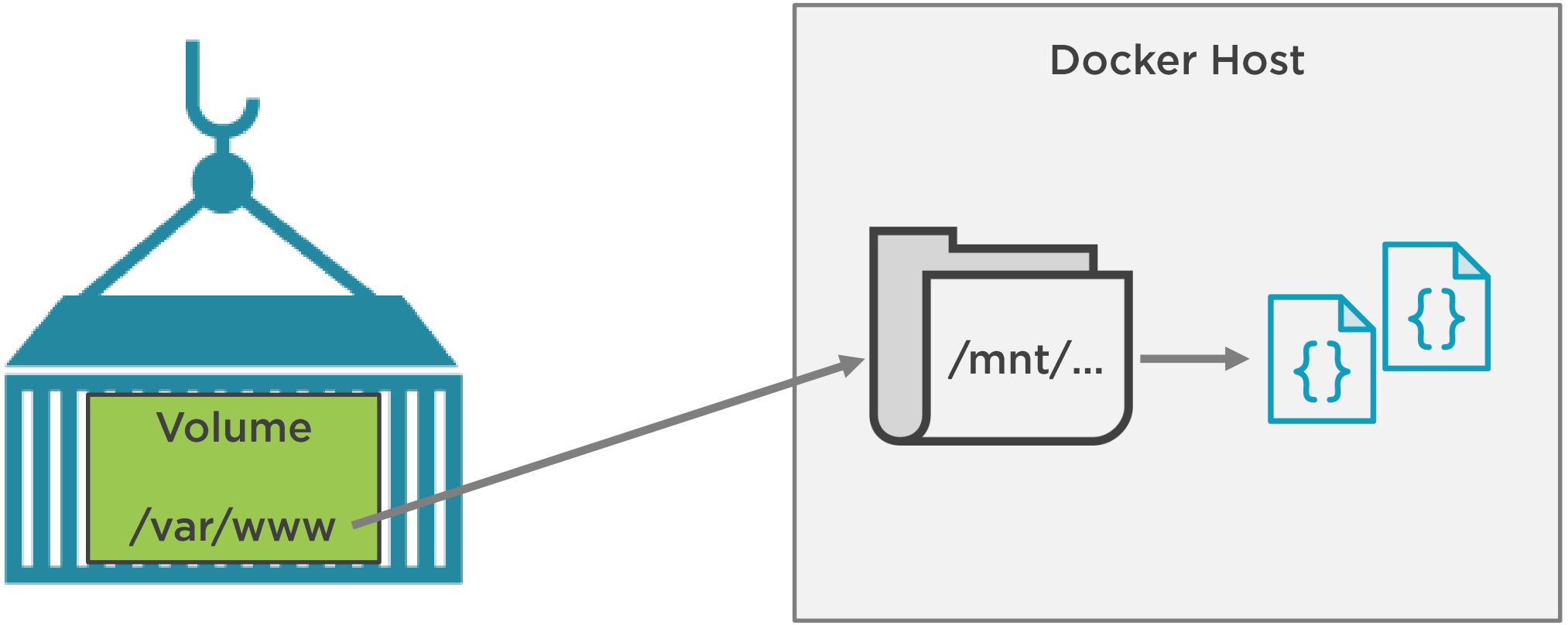
Special type of directory in a container typically referred to as a "data volume"

Can be shared and reused among containers

Updates to an image won't affect a data volume

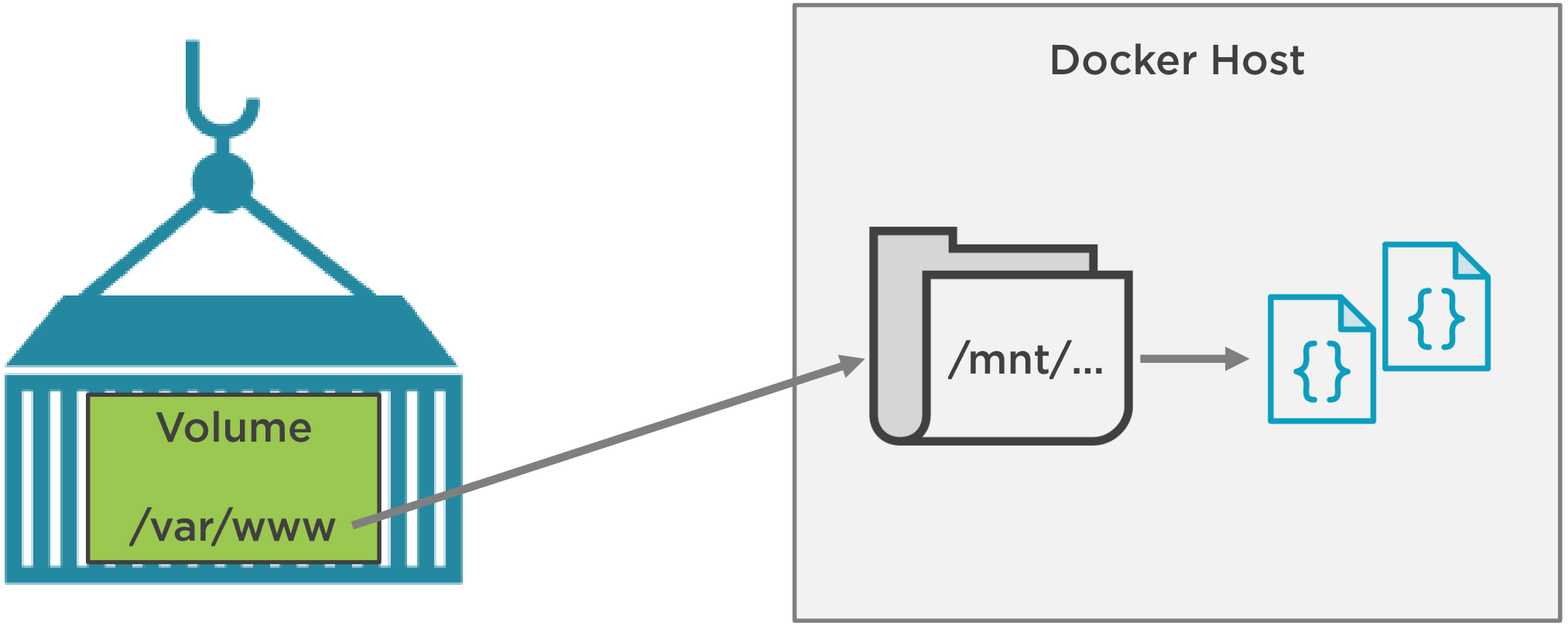
Data volumes are persisted even after the container is deleted

Volume Overview



Source Code, Volumes and Containers

Understanding Volumes



Creating a Data Volume

Container Volume

```
docker  run  -p 8080:3000  -v /var/www node
```

Create a Volume

Locating a Volume

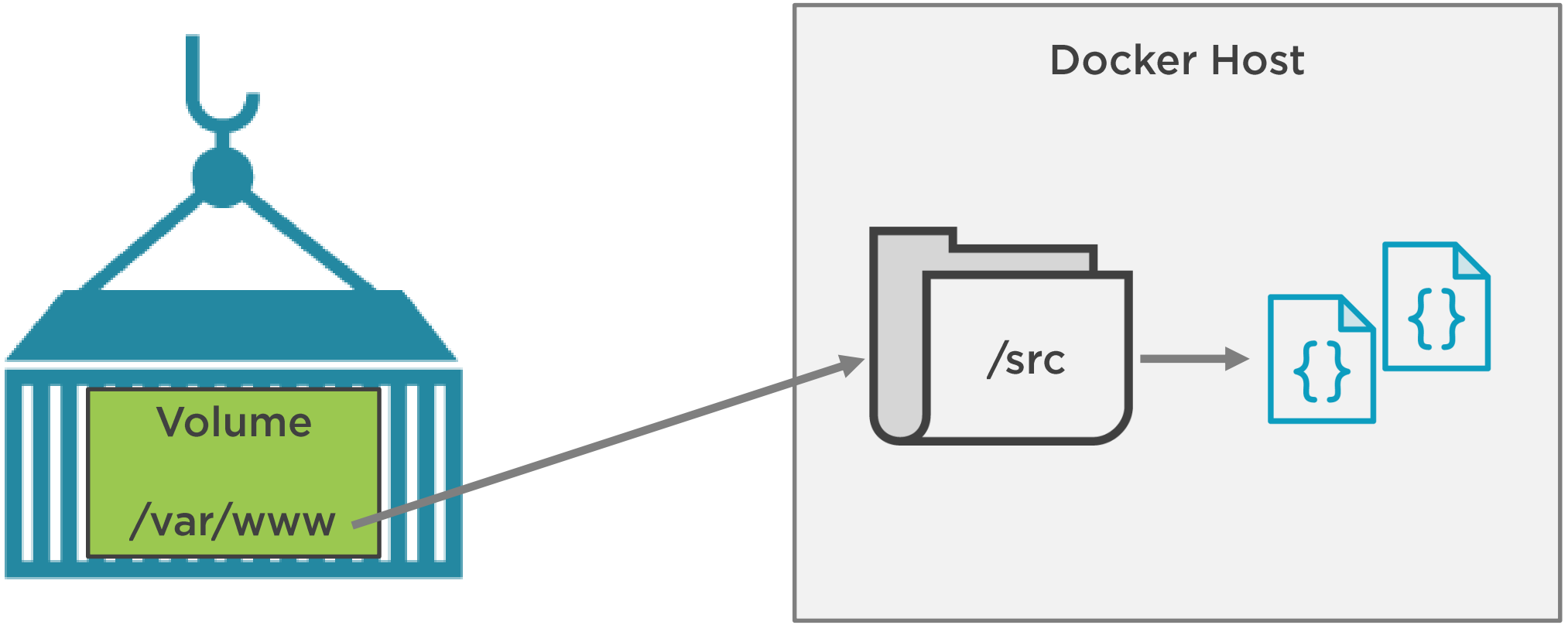
```
docker inspect mycontainer
```

Host Location

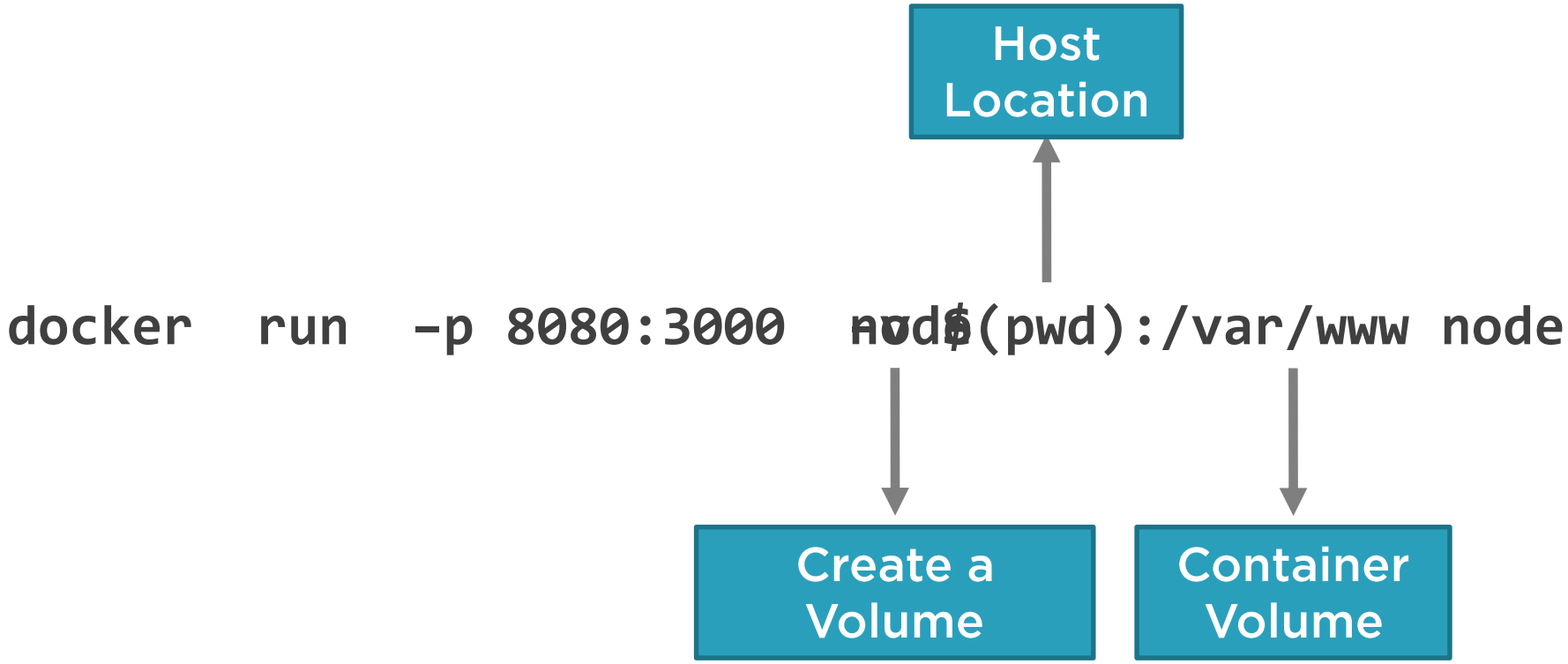
```
...
"Mounts": [
    {
        "Name": "d185...86459",
        "Source": "/mnt/.../var/lib/docker/volumes/d185...86459/_data",
        "Destination": "/var/www",
        "Driver": "local",
        "RW": true
    }
]
...
```

Volume Location in Container

Customizing Volumes



Customizing the Host Location for a Data Volume



Locating a Volume

```
docker inspect mycontainer
```

```
...
"Mounts": [
    {
        "Name": "d185...86459",
        "Source": "/src",
        "Destination": "/var/www",
        "Driver": "local",
        "RW": true
    }
]
...
```

Host Location

Volume Location in Container

Hooking a Volume to Node.js Source Code

Hooking a Volume to ASP.NET Core Source Code

Removing Containers and Volumes

Creating a Docker Managed Volume

```
docker  run  -p 8080:3000  -v /var/www node
```

Docker Controlled Volumes

```
docker inspect mycontainer
```

↓

```
...
"Mounts": [
    {
        "Name": "d185...86459",
        "Source": "/mnt/.../var/lib/docker/volumes/d185...86459/_data",
        "Destination": "/var/www",
        "Driver": "local",
        "RW": true
    }
]
...
```

Removing Volumes

```
docker rm -v lastContainer
```

Summary

Docker images and containers rely on a "layered file system"

Source Code can be hooked to a container using volumes:
docker run –v

Volumes are persisted on the Docker Host

Volumes can be removed using:
docker rm –v lastContainer

Building Custom Images with Dockerfile

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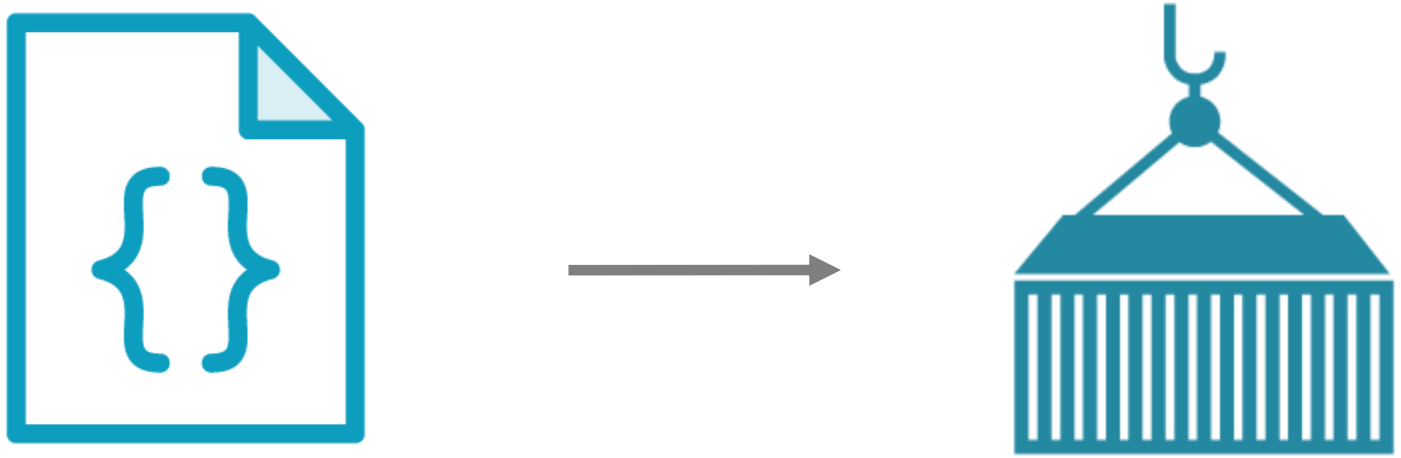
Module Agenda

- Getting Started with Dockerfile
- Creating a Custom DockerFile
- Building a Custom Image
- Publishing an Image to Docker Hub

Question

How do you get source code into a container?



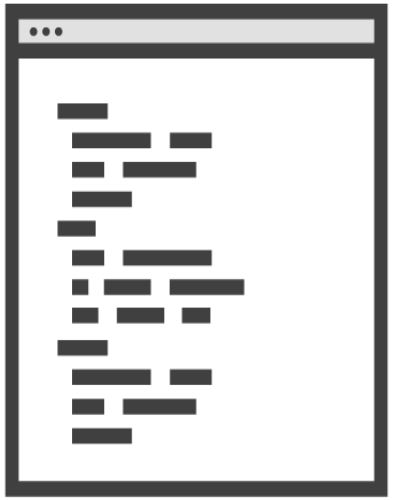
Answer

1. Create a container volume that points to the source code.

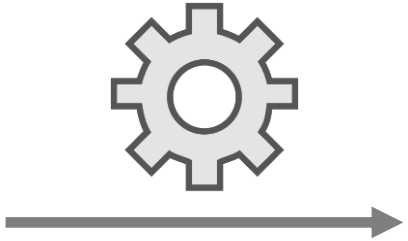
2. Add your source code into a custom image that is used to create a container.

Getting Started with Dockerfile

Dockerfile and Images



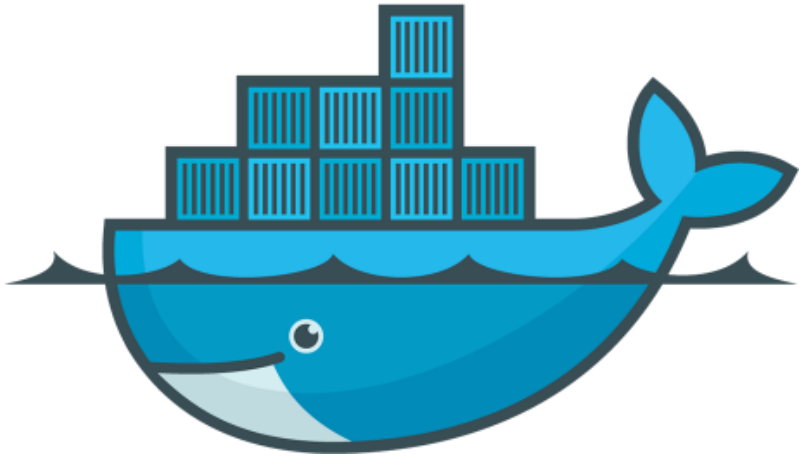
Dockerfile



docker build

Docker Image

Dockerfile Overview



Text file used to build Docker images

Contains build instructions

Instructions create intermediate image that can be cached to speed up future builds

Used with "docker build" command

Key Dockerfile Instructions

FROM	LABEL (ex: maintainer/author)	RUN
COPY	ENTRYPOINT	WORKDIR
EXPOSE	ENV	VOLUME

Dockerfile Example

```
FROM        node
LABEL       author="Dan"
COPY        .  /var/www
WORKDIR     /var/www
RUN         npm install
EXPOSE      8080
ENTRYPOINT  ["node", "server.js"]
```

Creating a Custom Node.js Dockerfile

Building a Node.js Image

Building a Custom Image

Tag name

```
docker  build  -t <your username>/node .
```

Short for --tag

Build context

Creating a Custom ASP.NET Core Dockerfile

Building an ASP.NET Core Image

Building a Custom Image

```
docker  build  -t <your username>/aspnetcore .
```

Tag name

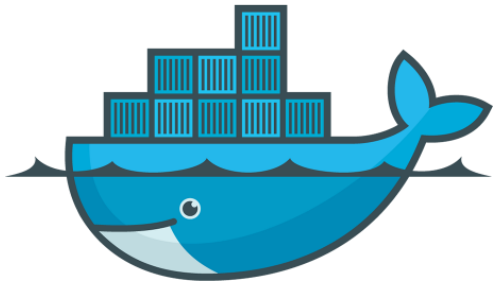
Short for --tag

Build context

Publishing an Image to Docker Hub

Publishing an Image to Docker Hub

```
docker push <your username>/node
```



Docker Registry

Summary

Dockerfile is a simple text file with instructions that is used to create an image

Each Dockerfile starts with a FROM instruction

Custom images are built using:
docker build –t <username>/imageName

Images can be pushed to Docker Hub

Communicating between Docker Containers

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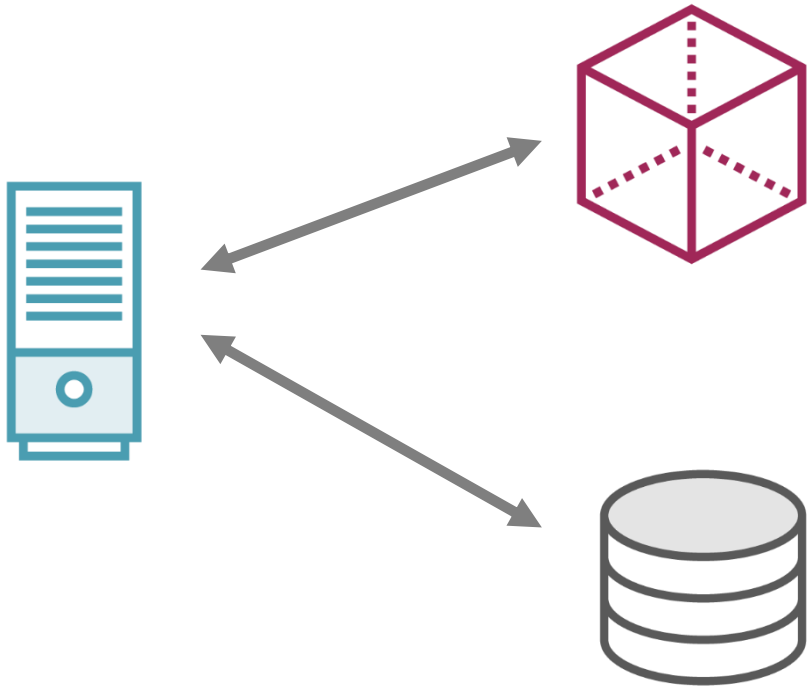
Module Agenda

- Getting Started with Container Linking
- Linking Containers by Name (legacy linking)
- Container Linking in Action
- Getting Started with Container Networks
- Container Networks in Action
- Linking Multiple Containers

Getting Started with Container Linking

The Need for Linked Containers



Docker Container Linking Options

Use Legacy Linking

Add Containers to a Bridge Network

Linking Containers by Name (legacy linking)

Steps to Link Containers

1. Run a Container with a Name
2. Link to Running Container by Name
3. Repeat for Additional Containers

1 Run a Container with a Name

```
docker run -d --name my-postgres postgres
```

Define a name for the container

2 Link to Running Container By Name

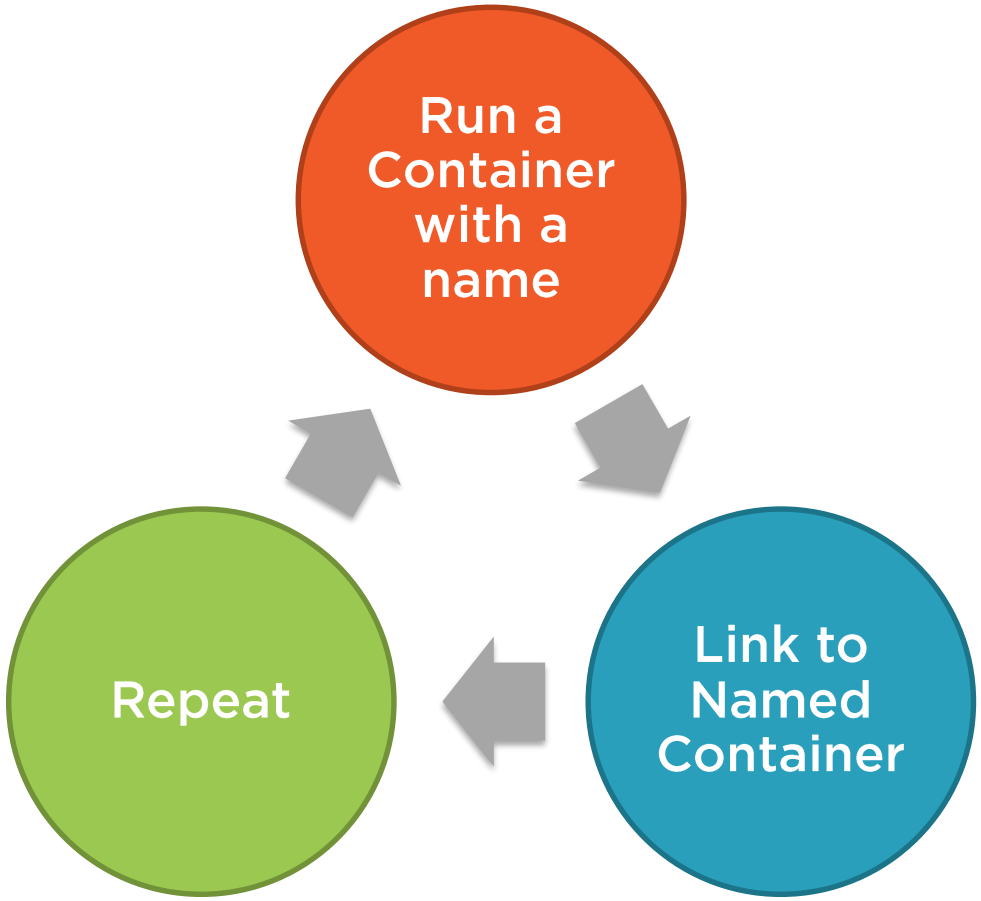
Name of linked container

```
docker run -d -p 5000:5000 --link my-postgres:postgres danwahlin/aspnetcore
```

Link to named container

Linked container alias

3 Repeat for Additional Containers

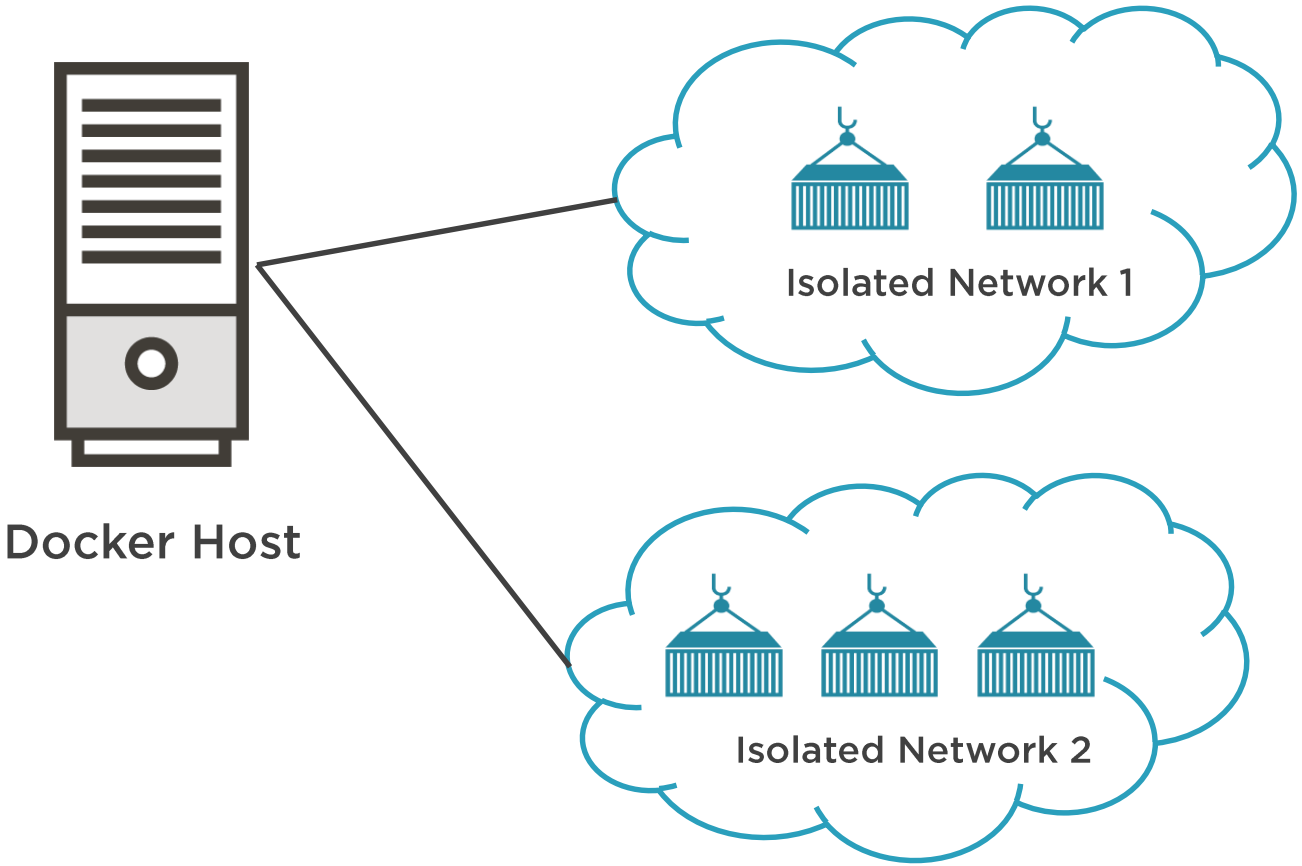


Linking Node.js and MongoDB Containers

Linking ASP.NET Core and PostgreSQL Containers

Getting Started with Container Networks

Understanding Container Networks



Steps to Create a Container Network

Create a Custom Bridge Network

1

Run Containers in the Network

2

1 Create a Custom Container Network

Name of custom network

```
docker network create --driver bridge isolated_network
```

Create a custom network

Use a bridge network

2 Run Containers in the Container Network

"Link" to this container by name

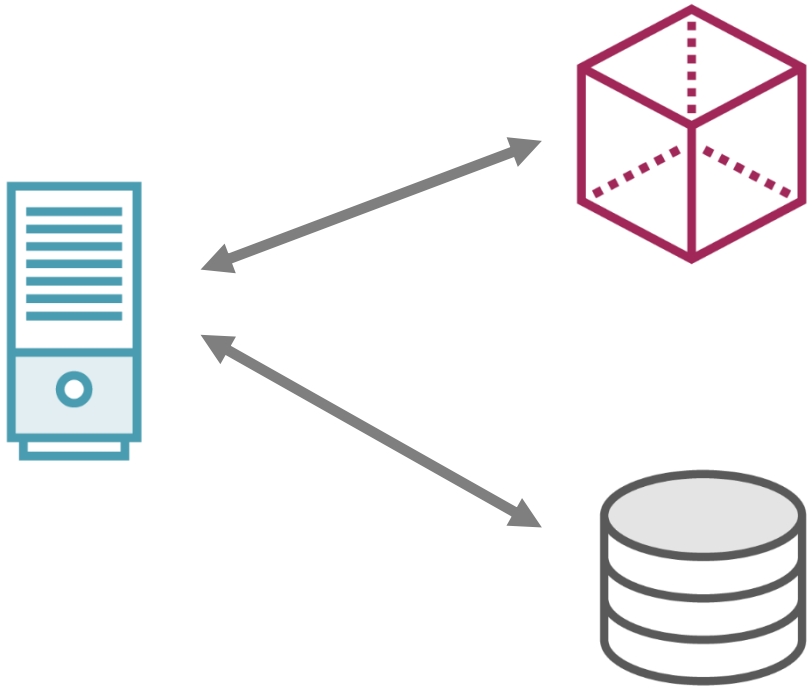
```
docker run -d --net=isolated_network --name mongodb mongo
```

Run container in network

Container Networks in Action

Linking Multiple Containers

Is There an Easier Way?



Docker Compose Can Simplify Container Linking

Summary

Docker containers communicate using link or network functionality

The –-link switch provides "legacy linking"

The --net command-line switch can be used to setup a bridge network

Docker Compose can be used to link multiple containers to each other

Managing Containers with Docker Compose

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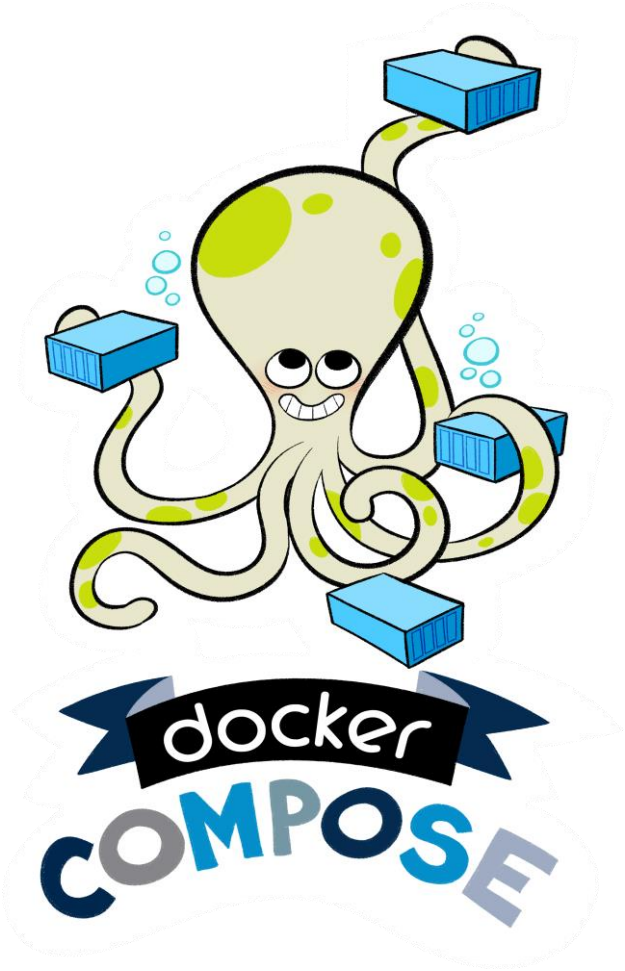
Module Agenda

- Getting Started with Docker Compose
- The docker-compose.yml File
- Docker Compose Commands
- Docker Compose in Action
- Setting Up Development Environment Services
- Creating a Custom docker-compose.yml File
- Managing Development Environment Services

Getting Started with Docker Compose

Docker Compose Manages Your Application Lifecycle

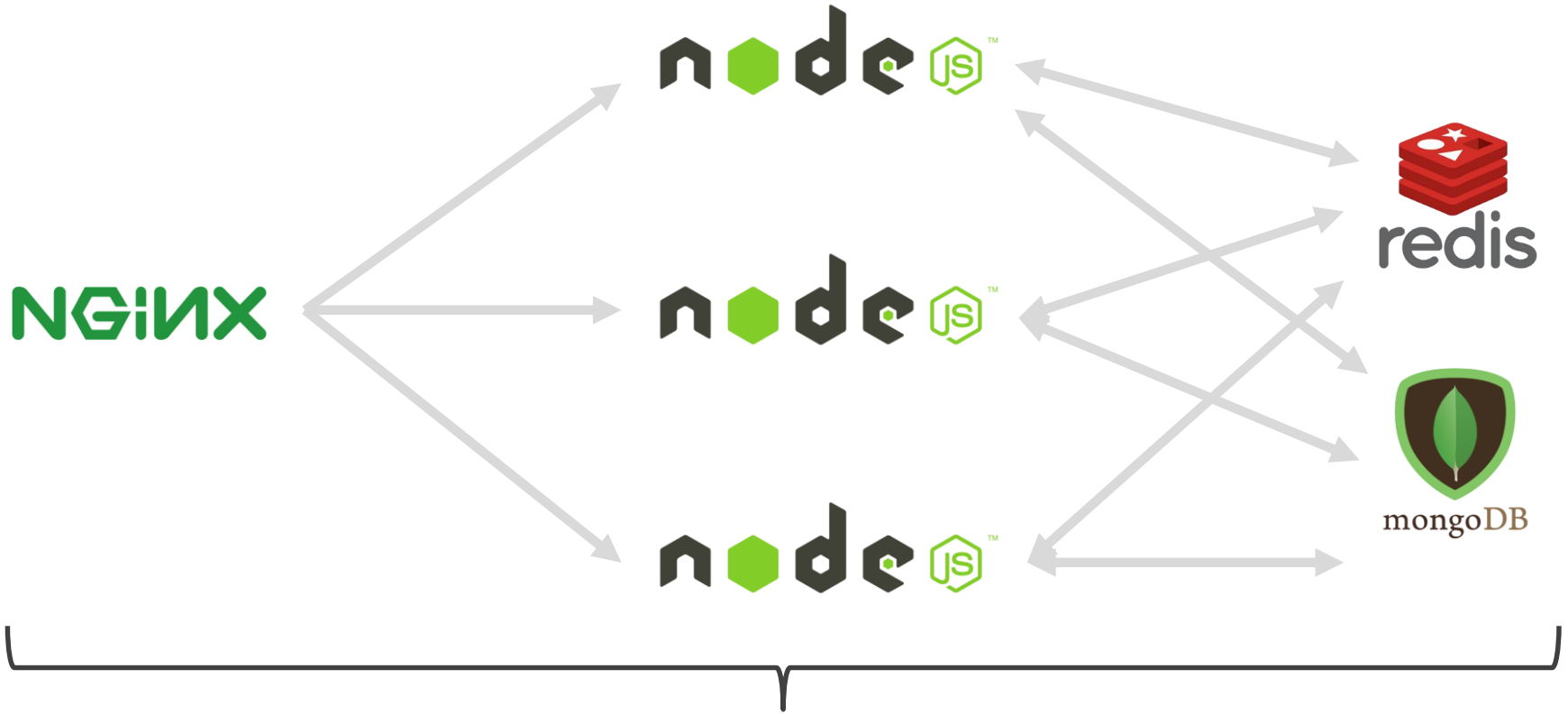


Docker Compose Features

Manages the whole application lifecycle:

- Start, stop and rebuild services
- View the status of running services
- Stream the log output of running services
- Run a one-off command on a service

The Need For Docker Compose

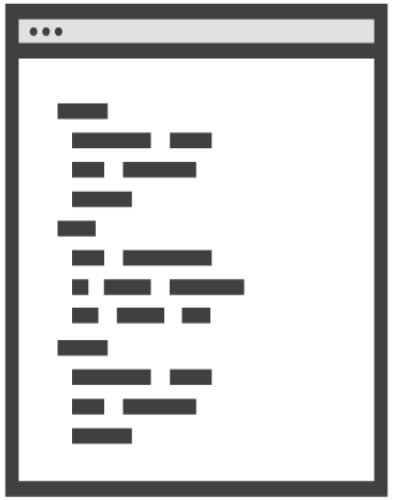


Docker Compose
(docker-compose.yml)

Docker Compose Workflow

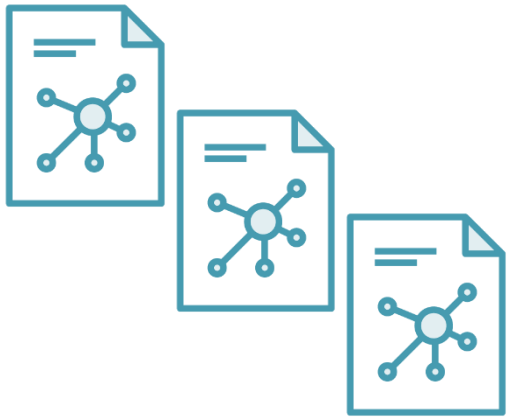
The docker-compose.yml File

The Role of the Docker Compose File



docker-compose.yml
(service configuration)

Docker Compose
Build



Docker Images
(services)

Docker Compose and Services

version: "3.x"

services:

docker-compose.yml

Key Service Configuration Options

build	environment	image
networks	ports	volumes

docker-compose.yml Example

```
version: "3.x"
services:
  node:
    build:
      context: .
      dockerfile: node.dockerfile
    networks:
      -nodeapp-network

  mongodb:
      image: mongo
      networks:
        - nodeapp-network

networks:
  nodeapp-network
    driver: bridge
```

Docker Compose Commands

Key Docker Compose Commands

docker-compose build

docker-compose up

docker-compose down

docker-compose logs

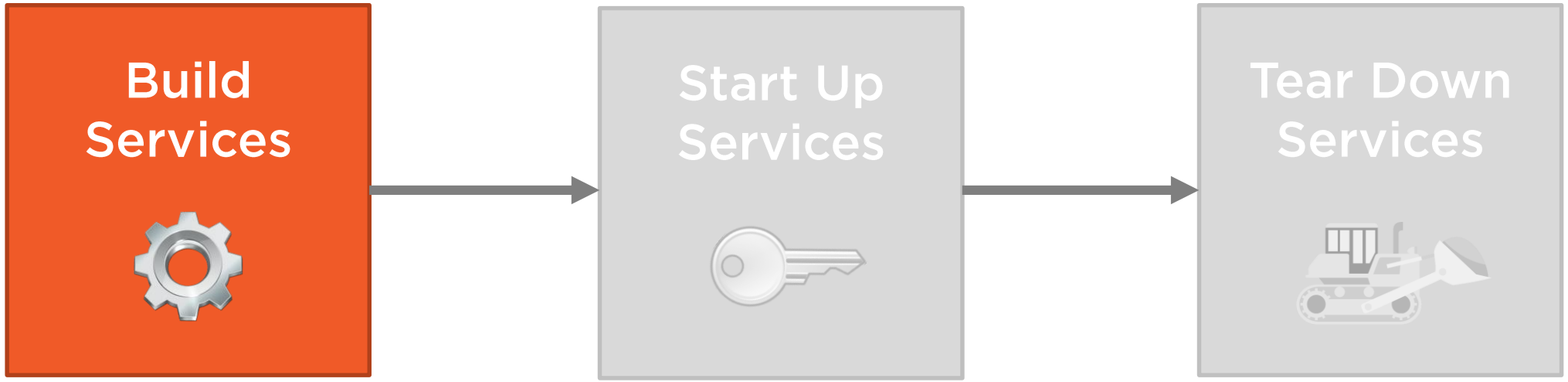
docker-compose ps

docker-compose stop

docker-compose start

docker-compose rm

Building Services



Building Services

```
docker-compose build
```

Build or rebuild services defined in docker-compose.yml

Building Specific Services

```
docker-compose build mongo
```

Only build/rebuild mongo service

Starting Services Up

Creating and Starting Containers

```
docker-compose up
```

↓

Create and start the containers

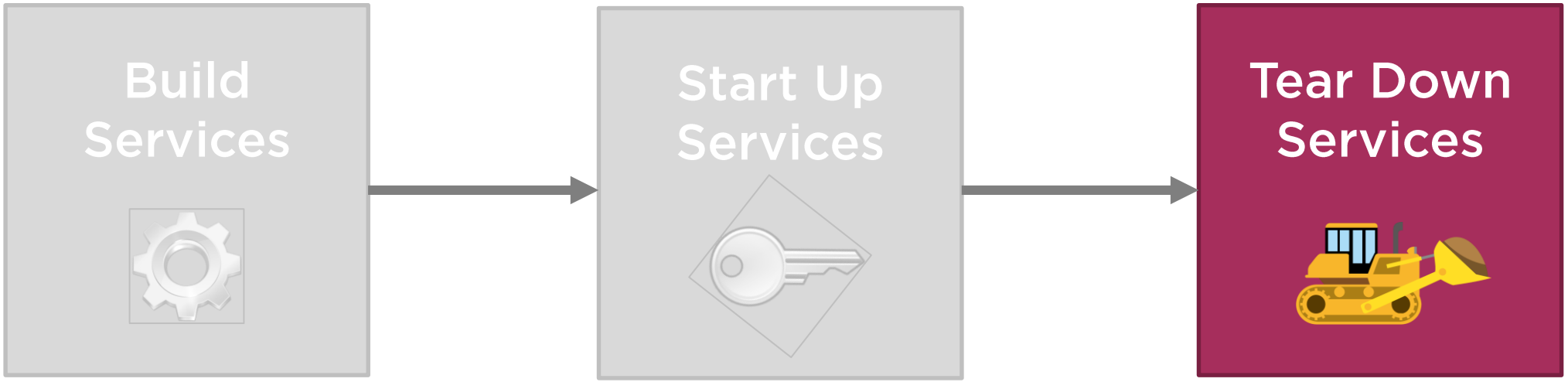
Creating and Starting Containers

Rebuild node image and stop, destroy and recreate *only* node

```
docker-compose up --no-deps node
```

Do not recreate services that node depends on

Tearing Down Services



Stop and Remove Containers

```
docker-compose down
```

Take all of the containers down (stop and remove)

Stop and Remove Containers, Images, Volumes

Remove all volumes

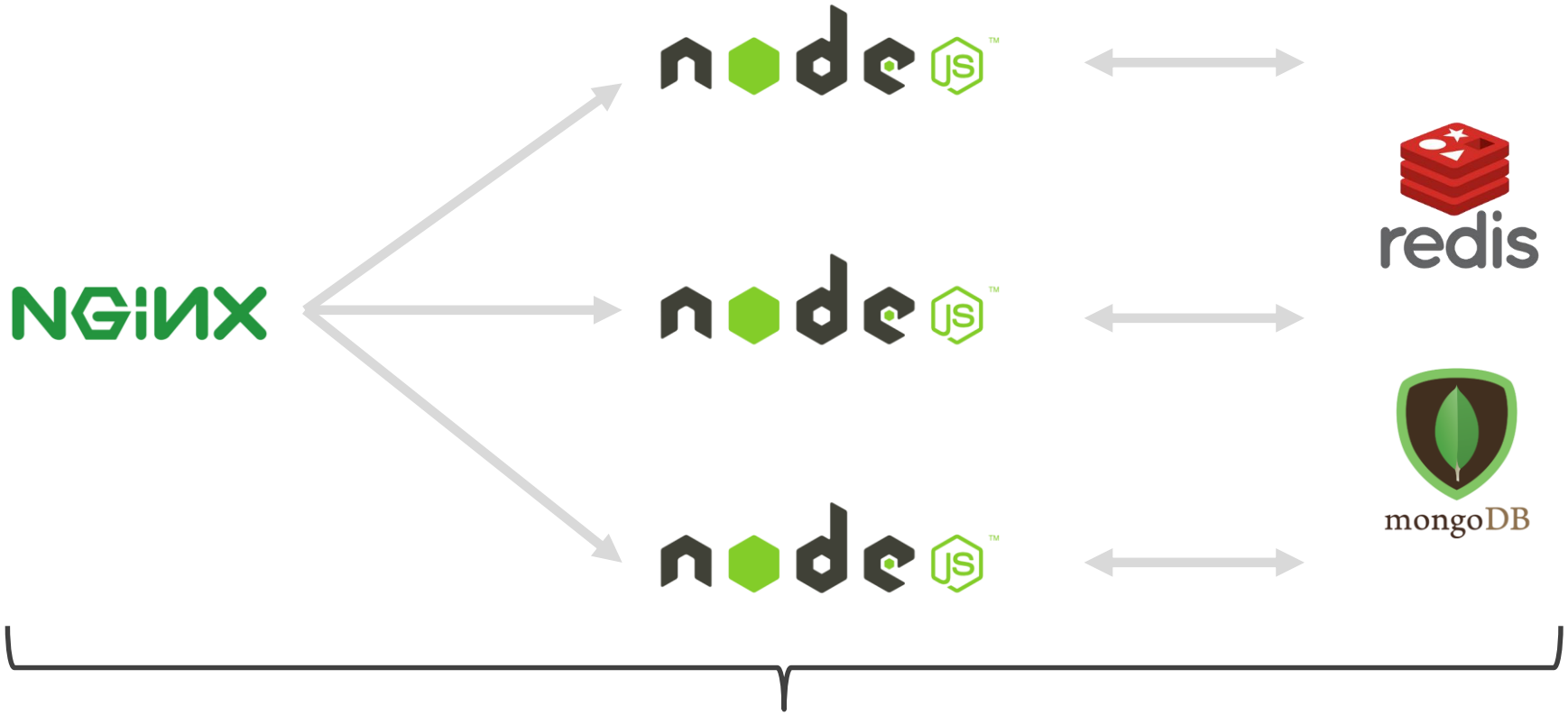
```
docker-compose down --rmi all --volumes
```

Remove all images

Docker Compose in Action

Setting Up Development Environment Services

Development Environment Services



Docker Compose
(docker-compose.yml)

Creating a Custom docker-compose.yml File

Managing Development Environment Services

Summary

Docker Compose simplifies the process of building, starting and stopping services

docker-compose.yml defines services

Excellent way to manage services used in a development environment

Key Docker Compose commands include "build", "up" and "down"

Moving to Kubernetes

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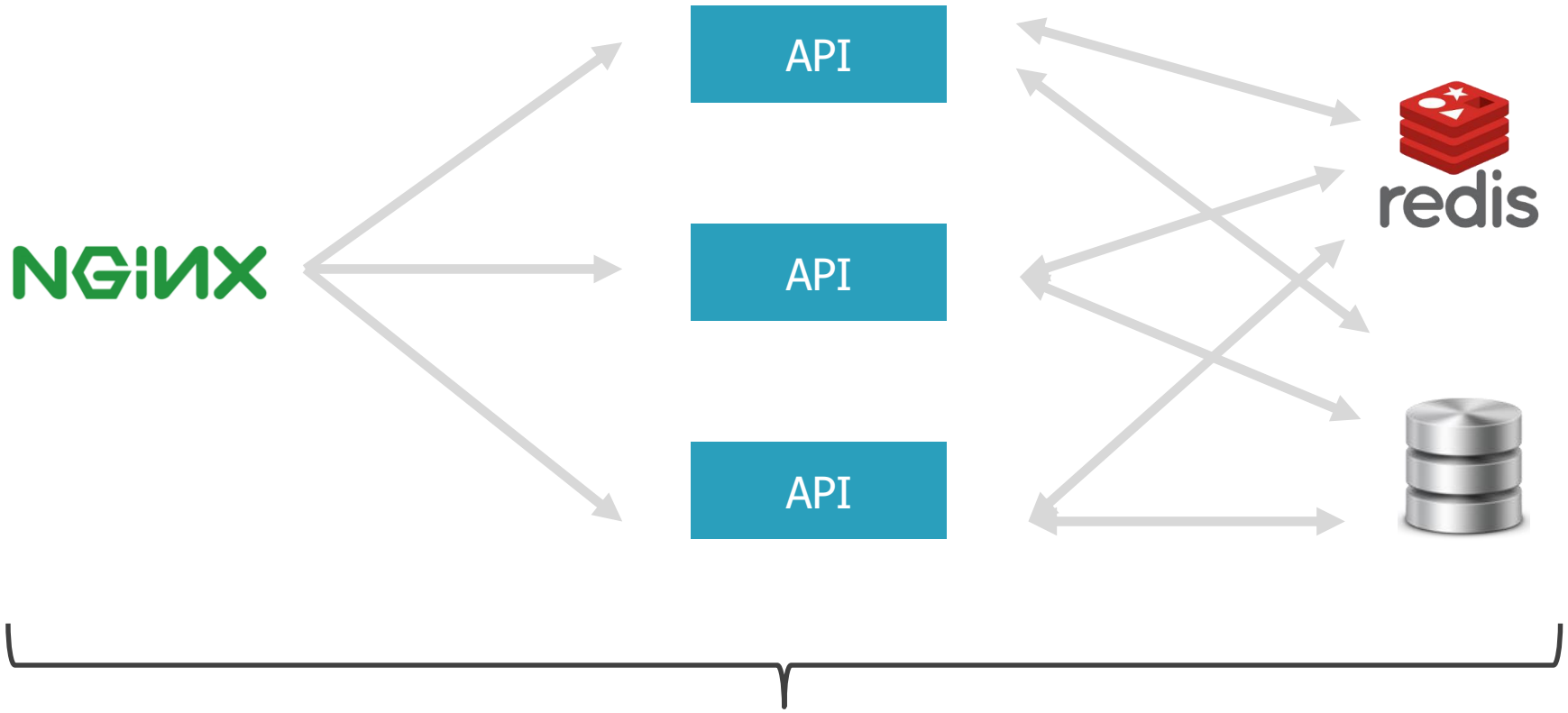
Module Agenda

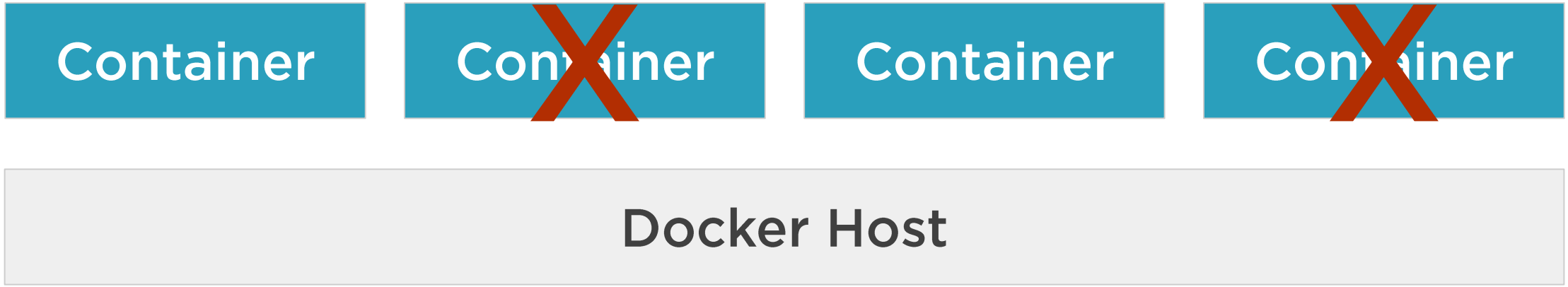
- Beyond Docker Compose
- Introduction to Kubernetes
- Converting from Docker Compose to Kubernetes
- Running Containers in Kubernetes
- Stopping and Removing Containers in Kubernetes

Beyond Docker Compose

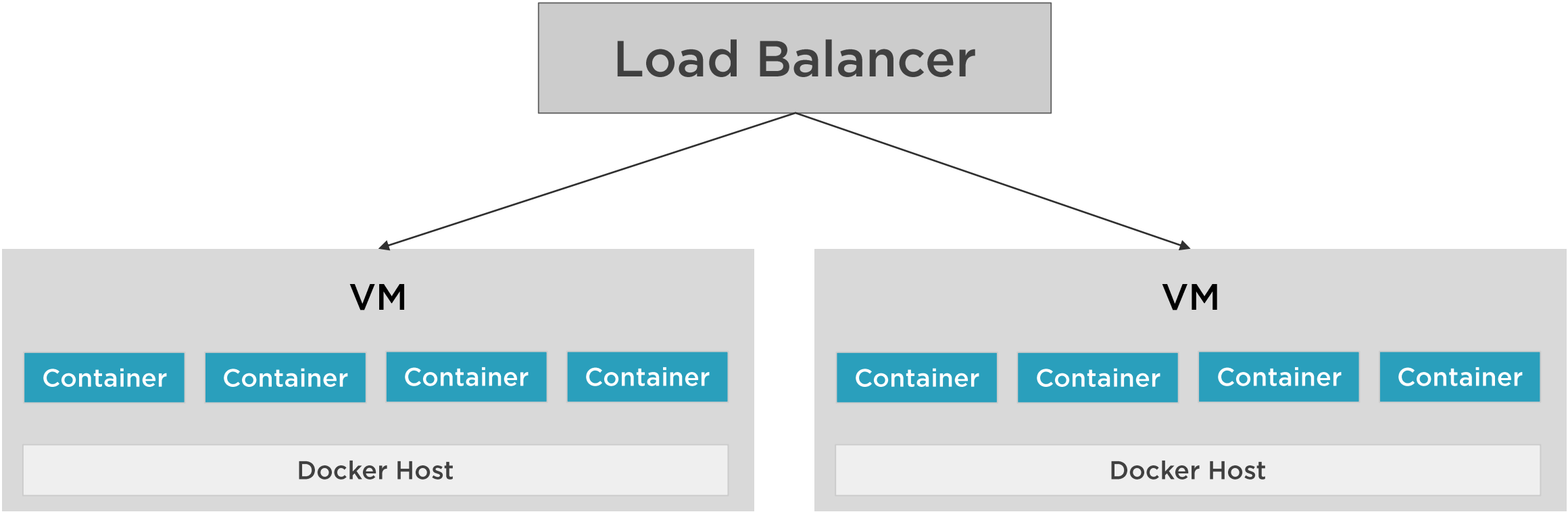


How do you manage all of these containers in test/stage/production?

How Are You Deploying/Managing Containers?



How Do You Scale and Load Balance VMs?



It Would Be Nice if You Could...

- Package up an app, provide a manifest, and let something else manage it for us
- Not worry about the management of containers
- Eliminate single points of failure and self-heal containers
- Have a robust way to scale and load balance containers
- Update containers without bringing down the application
- Have robust networking and persistent storage options

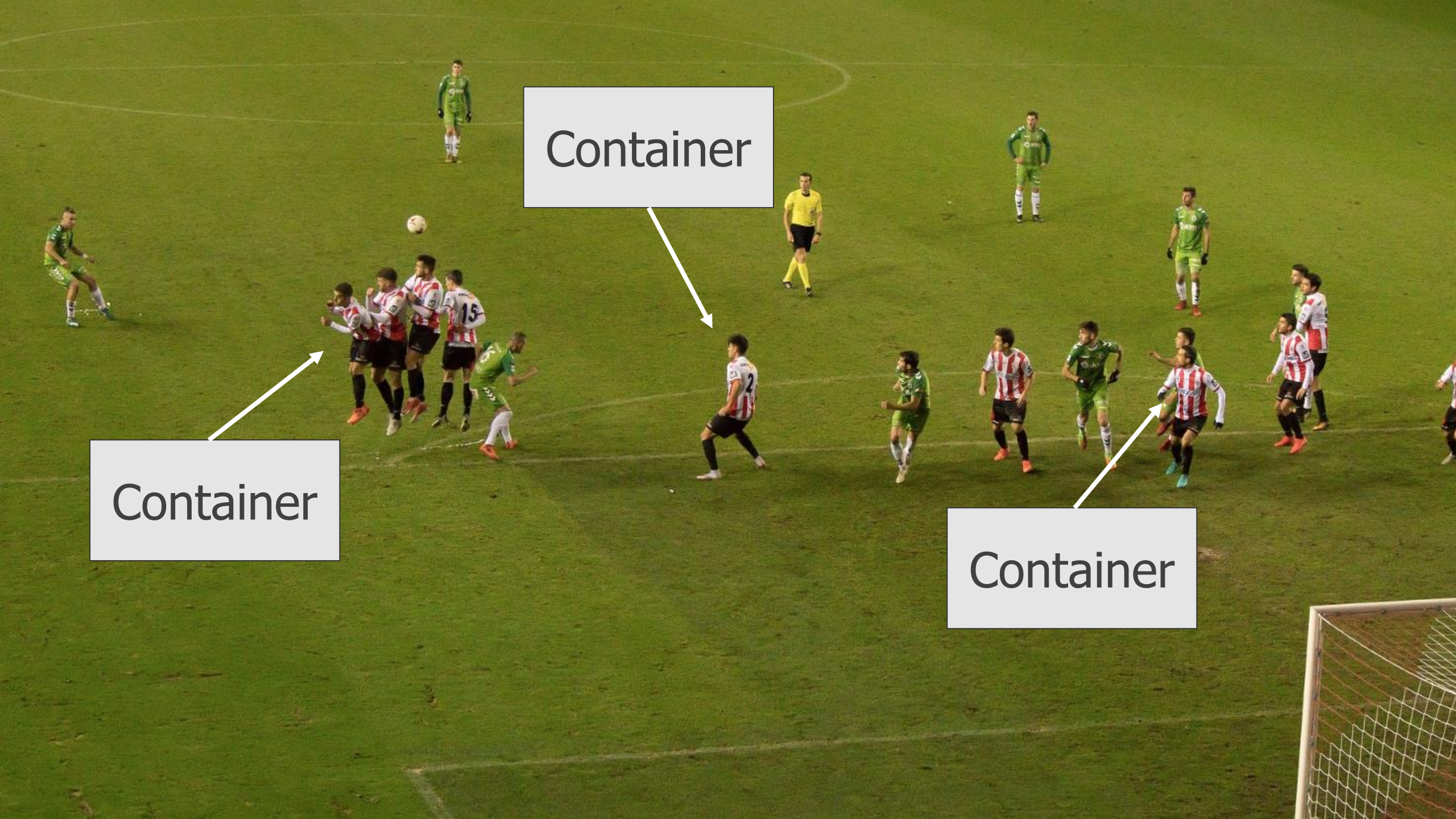
What if we could define the containers we want and then hand it off to a system that manages it all for us?

Welcome to Kubernetes!

Introduction to Kubernetes

“Kubernetes is an open-source system for automating deployment, scaling, and management of containerized applications.”

https://kubernetes.io


Container
Container
Container

“Kubernetes is the coach of a container team.”

Container
Kubernetes
(conductor)
Container
Container

“Kubernetes is the conductor of a container orchestra.”

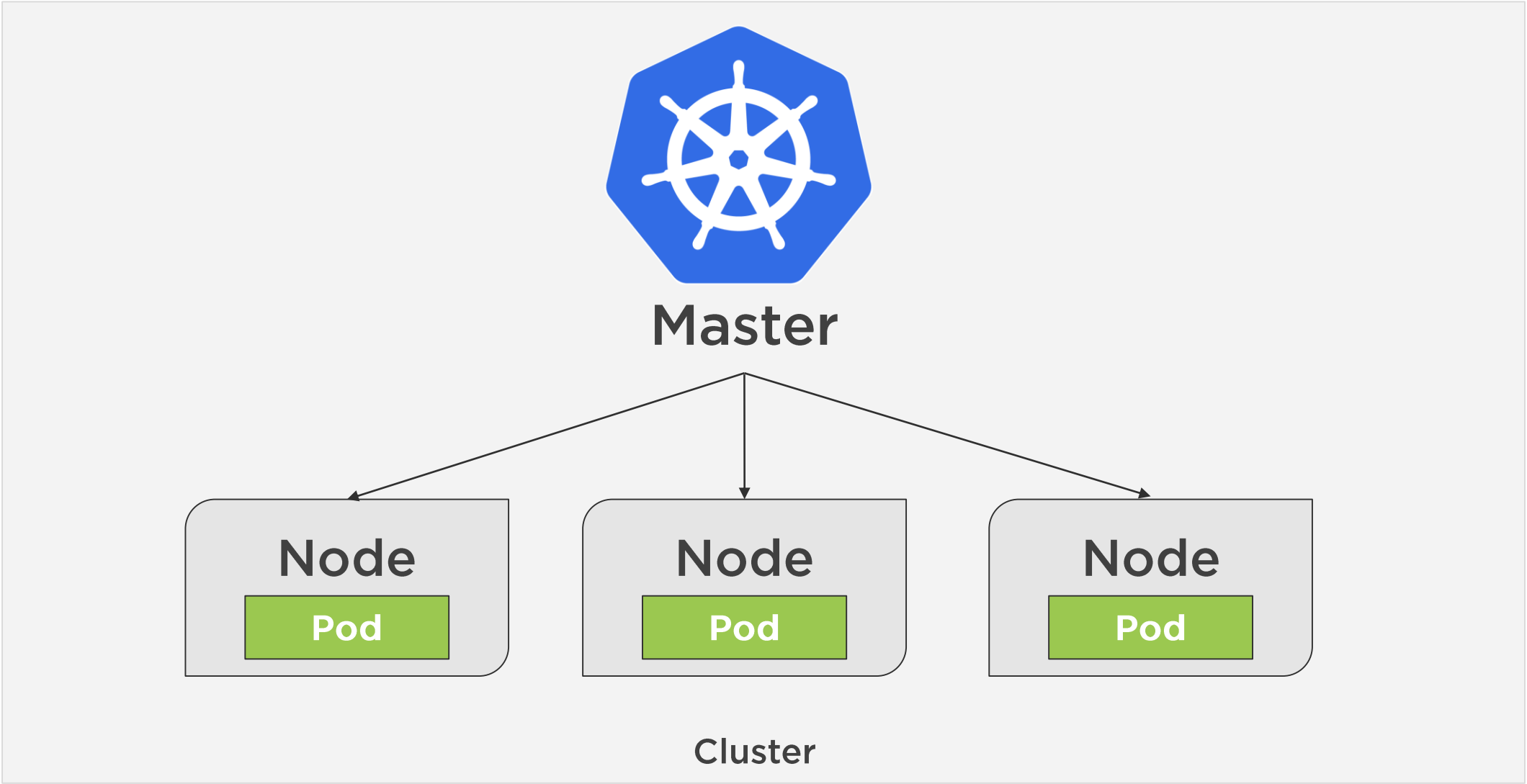
Kubernetes Overview

- Container and cluster management
- Supported by all major cloud platforms
- Provides a declarative way to define a cluster's state using manifest files (YAML)
- Interact with Kubernetes using kubectl

Key Features

- Service Discovery/ Load Balancing
- Storage Orchestration
- Automate Rollouts/Rollbacks
- Manage Workloads
- Self-healing
- Secret and Configuration Management
- Horizontal Scaling
- More

Kubernetes - The Big Picture



Running Kubernetes Locally

Running Kubernetes Locally

Minikube

https://github.com/kubernetes/minikube

Docker Desktop

https://www.docker.com/products/docker-desktop

Key Kubernetes Concepts

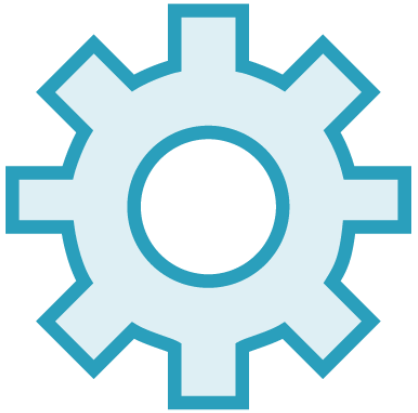
Deployment

Describe desired state

Can be used to replicate pods

Support rolling updates and rollbacks

Service

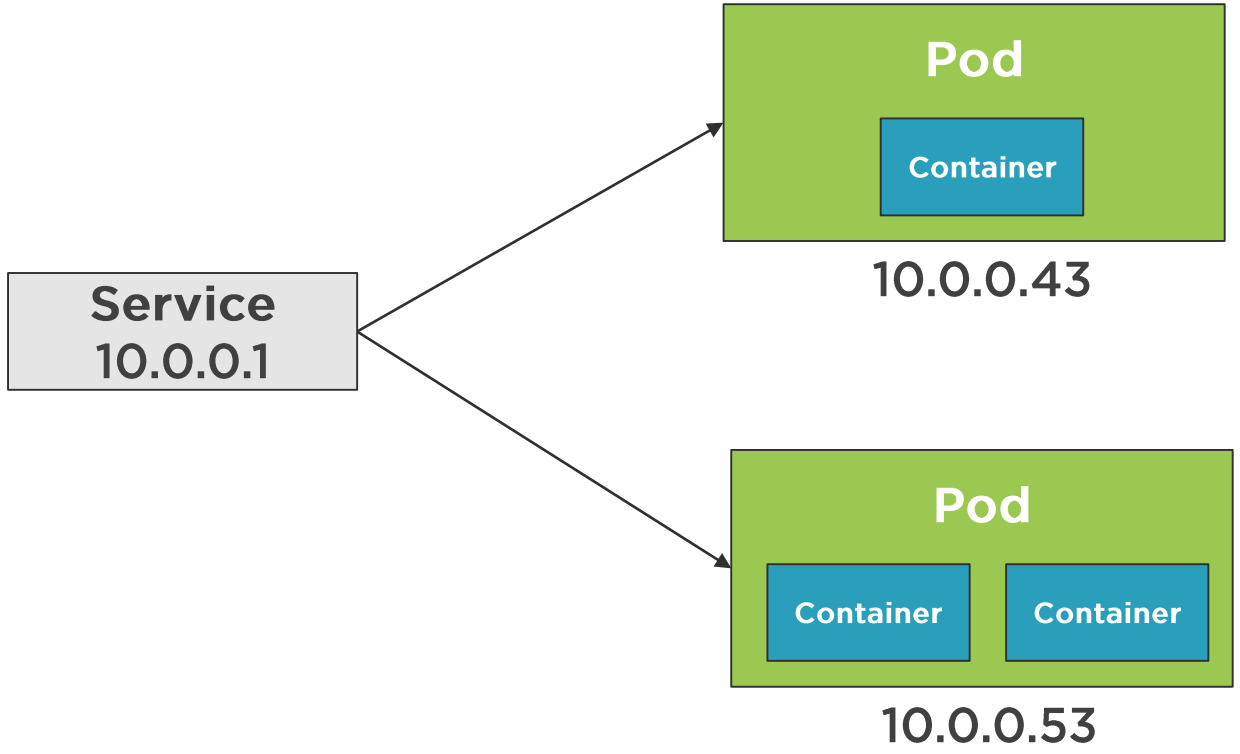


Pods live and die

Services abstract pod IP addresses from consumers

Load balances between pods

Services


Service
10.0.0.1
Pod
Container
10.0.0.43
Pod
Container
Container
10.0.0.53

Converting from Docker Compose to Kubernetes

Migrating from Docker Compose to Kubernetes

Compose on Kubernetes

https://github.com/docker/compose-on-kubernetes

Kompose

http://kompose.io

Running Containers in Kubernetes

```
kubectl version

kubectl get [deployments | services | pods]

kubectl run nginx-server --image=nginx:alpine

kubectl apply –f [fileName | folderName]

kubectl port-forward [name-of-pod] 8080:80
```

Stopping and Removing Containers in Kubernetes

kubectl delete –f [fileName | folderName]

Summary

Kubernetes provides a robust solution for automating deployment, scaling, and management of containers

Provides a way to move to a desired state

Relies on YAML (or JSON) files to represent desired state

Nodes and pods play a central role

A container runs in a pod

kubectl can be used to issue commands and interact with the Kubernetes API

Reviewing the Case for Docker

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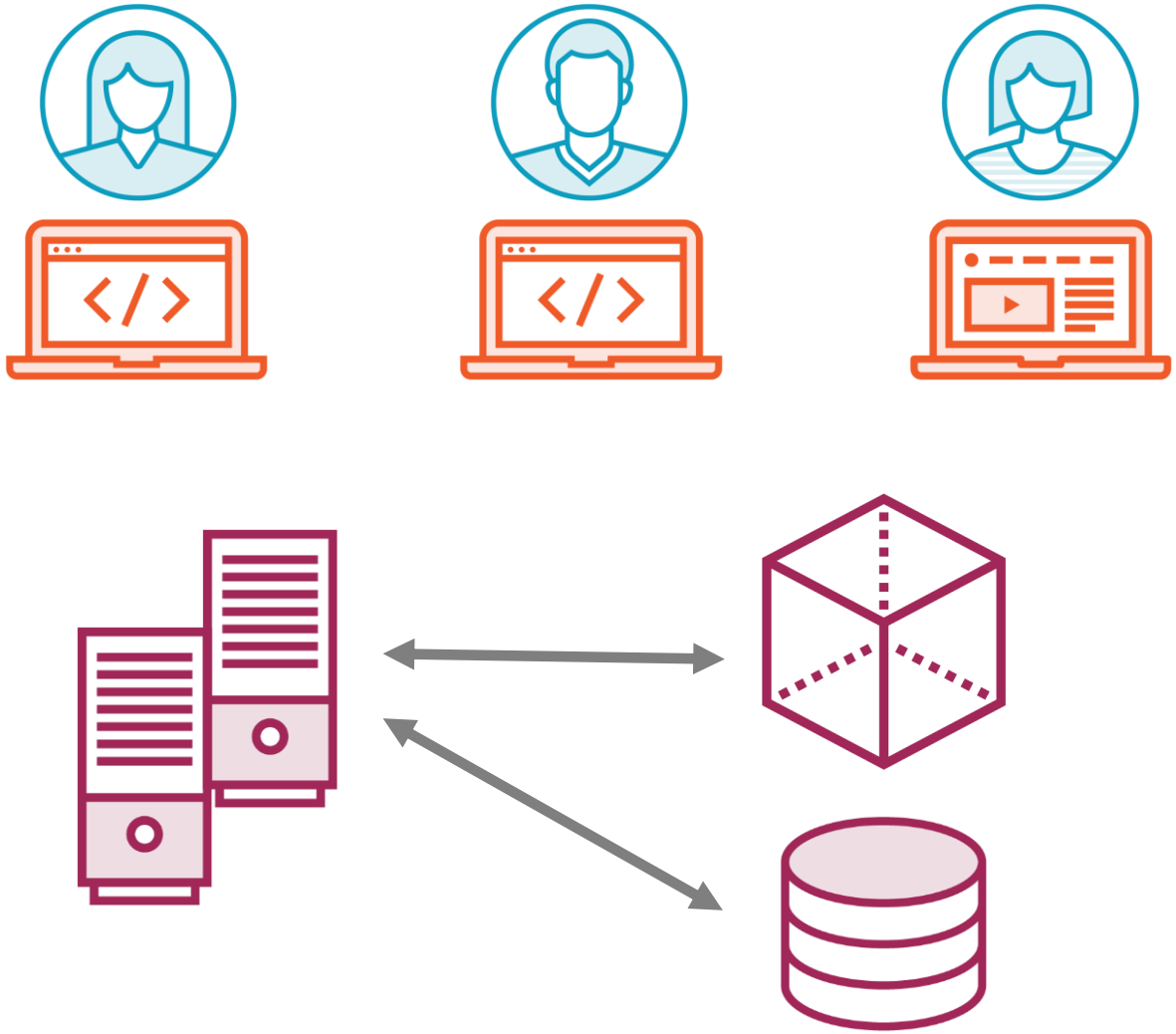
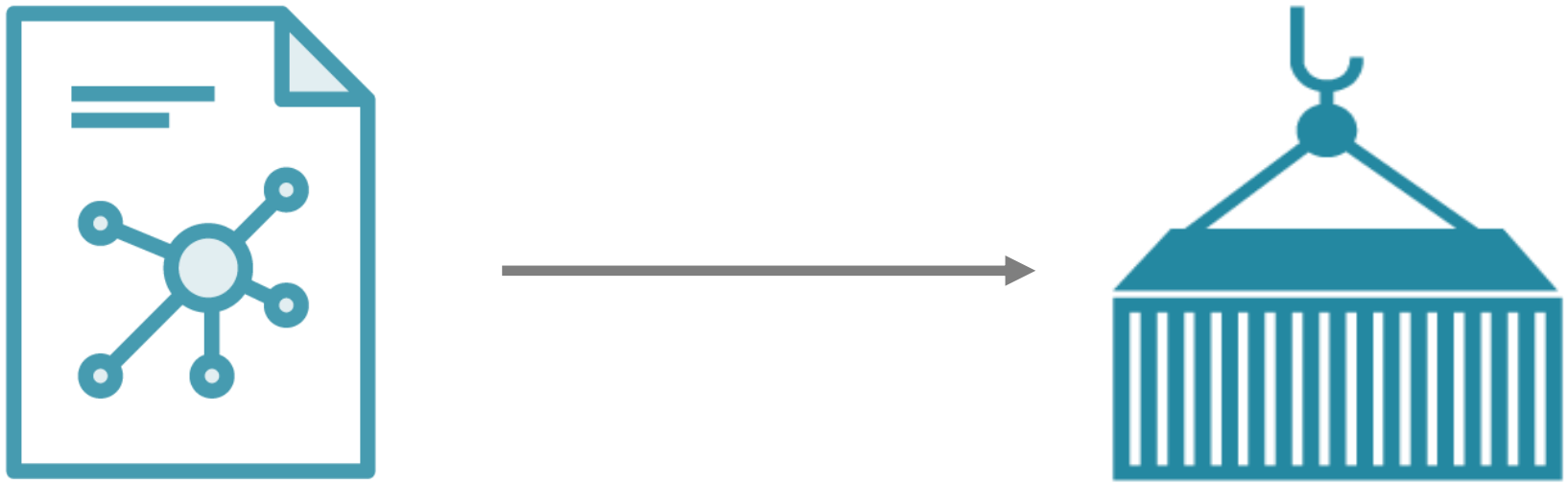
Docker Web Development Benefits



Images and Containers



Docker Image **Docker Container**

Docker Tools

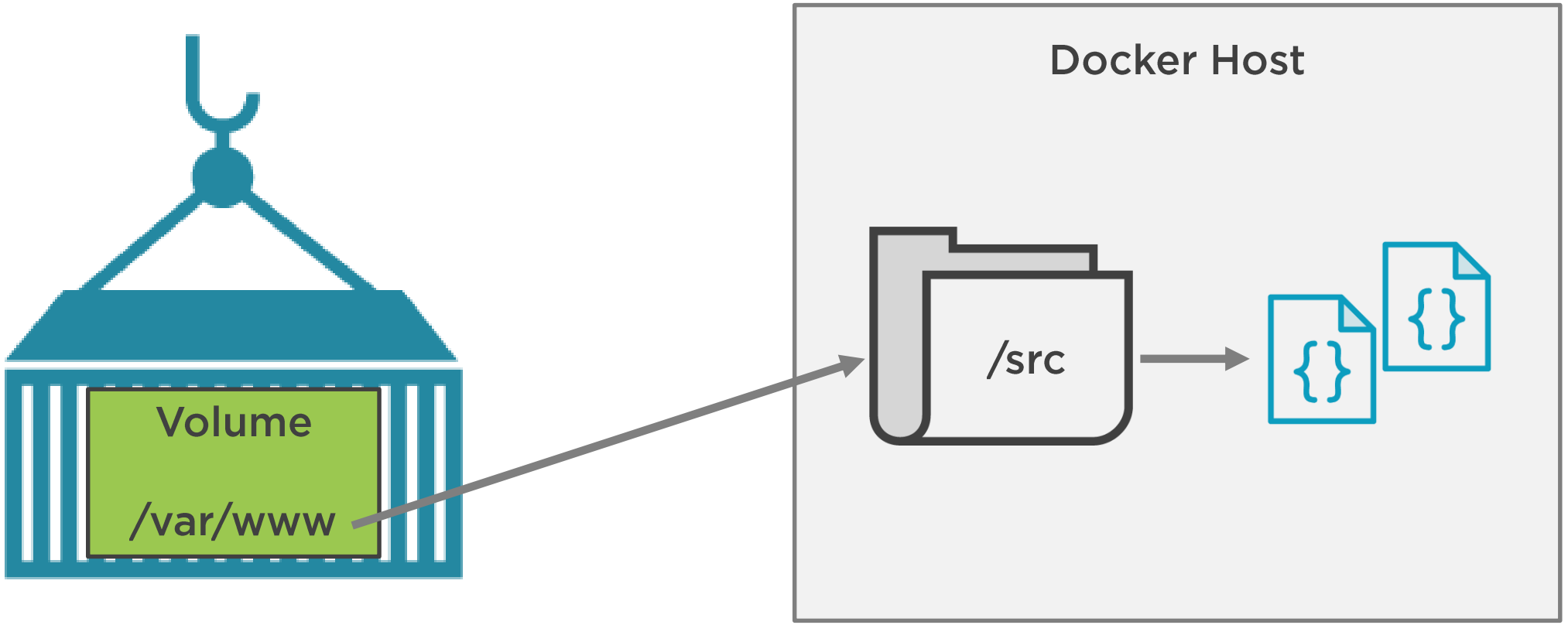
Docker Client

Docker Kitematic

Docker Machine
(Docker Toolbox Only)

Docker Compose

Docker Volumes



Dockerfile and Custom Images

```
FROM          node
LABEL         author="Dan"
COPY          .  /var/www
WORKDIR       /var/www
RUN           npm install
EXPOSE        8080
ENTRYPOINT    ["node", "server.js"]
```

Docker Compose

```
version: "3.x"
services:
  node:
    build:
      context: .
      dockerfile: node.dockerfile
    networks:
      -nodeapp-network

  mongodb:
     image: mongo
     networks:
       - nodeapp-network

networks:
  nodeapp-network
    driver: bridge
```

Thank You!

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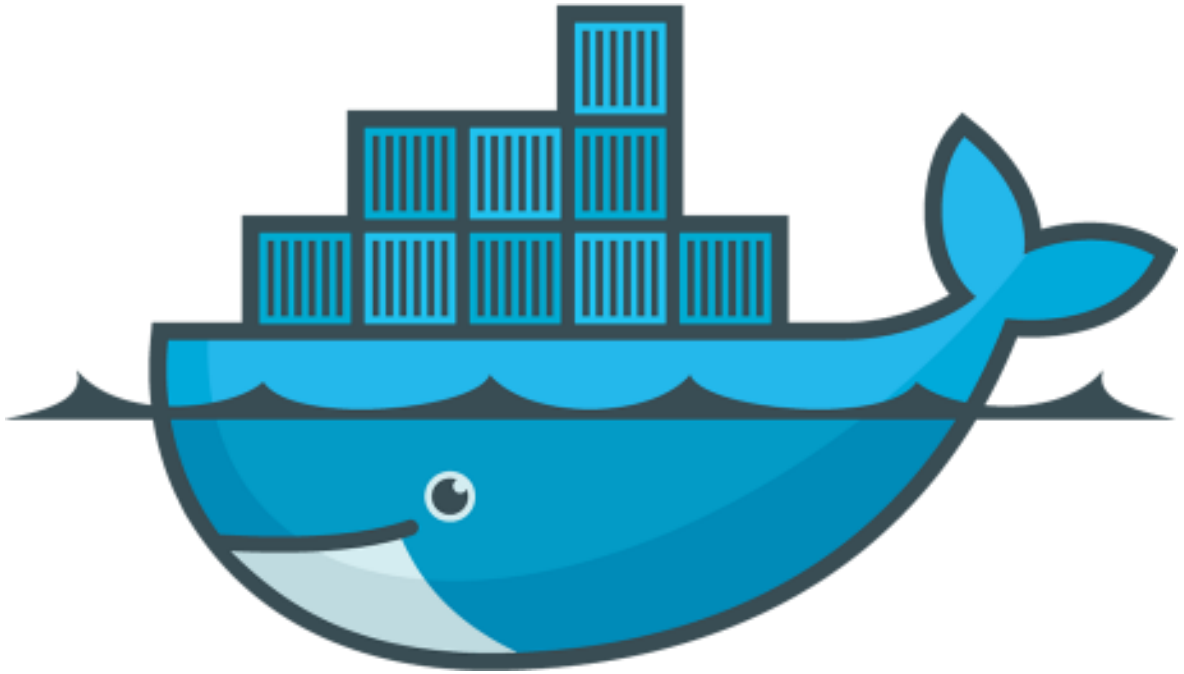

Docker