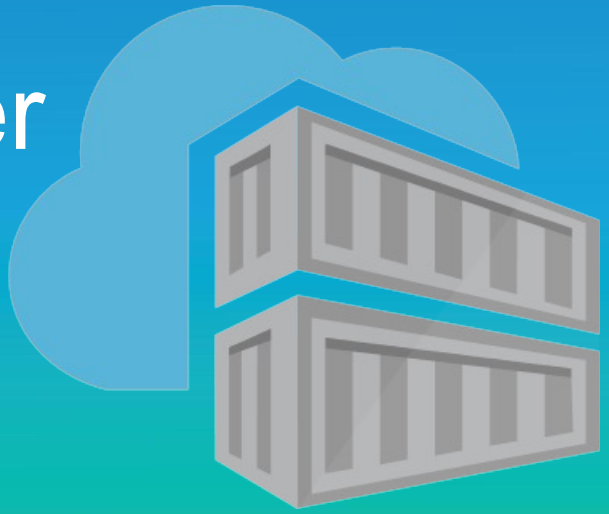
Introduction to Docker



CS370

docker

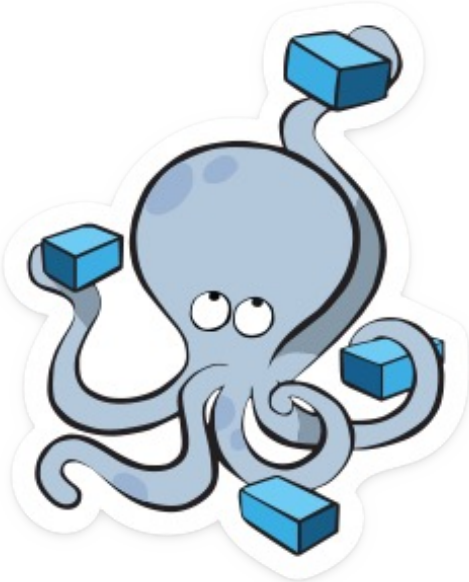
Agenda

Section 1:

What is Docker

What is Not Docker

Basic Docker Commands
Dockerfiles



Section 3:

Networking

Section 2:

Anatomy of a Docker image

Docker volumes

Section 4:

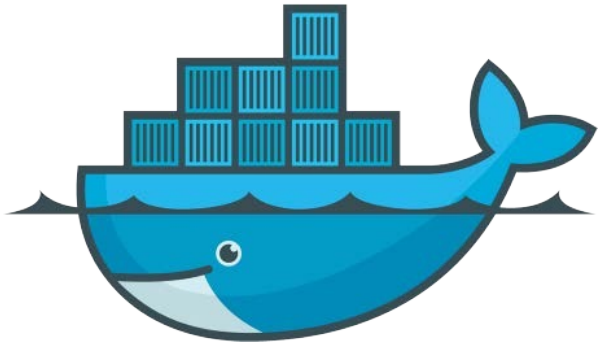
Docker compose / stacks

Demo

docker

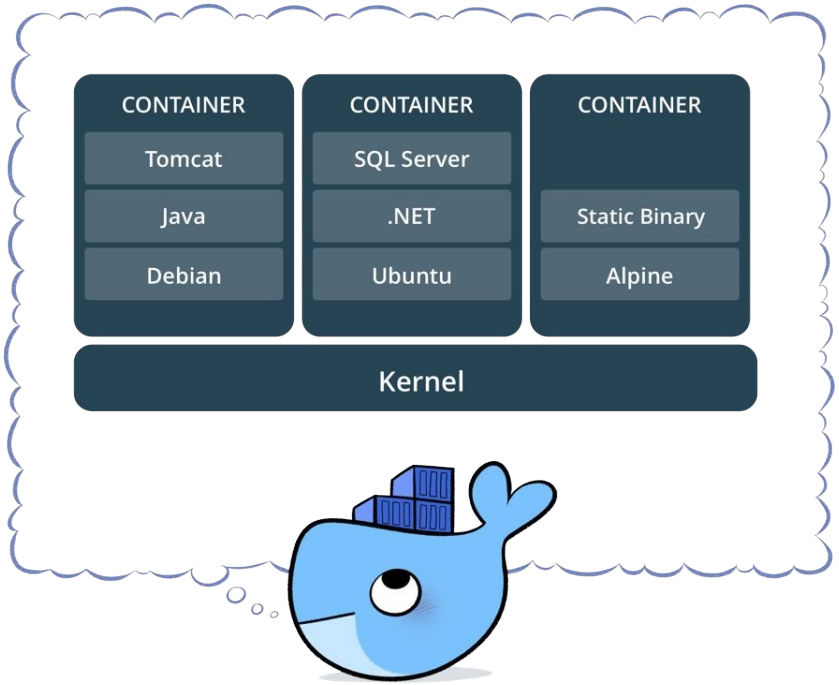
Section 1: What is Docker
Basic Docker Commands
Dockerfiles

What Is Docker?



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

What is a container?



- Standardized packaging for software and dependencies
- Isolate apps from each other
- Share the same OS kernel
- Works for all major Linux distributions
- Containers native to Windows Server 2016

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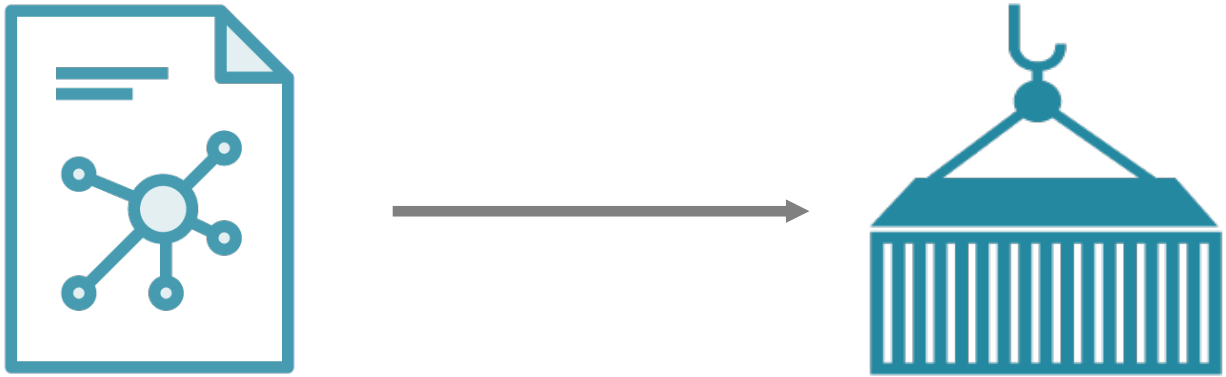
The Role of Images and Containers



Docker Image

Example: Ubuntu with Node.js and Application Code

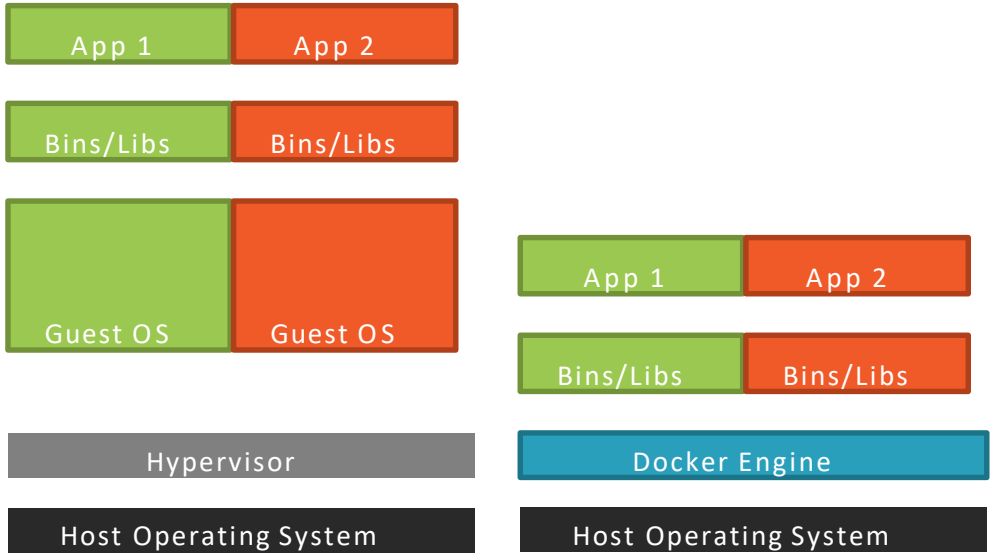
Docker Container

Created by using an image. Runs your application.

Docker containers are NOT VMs

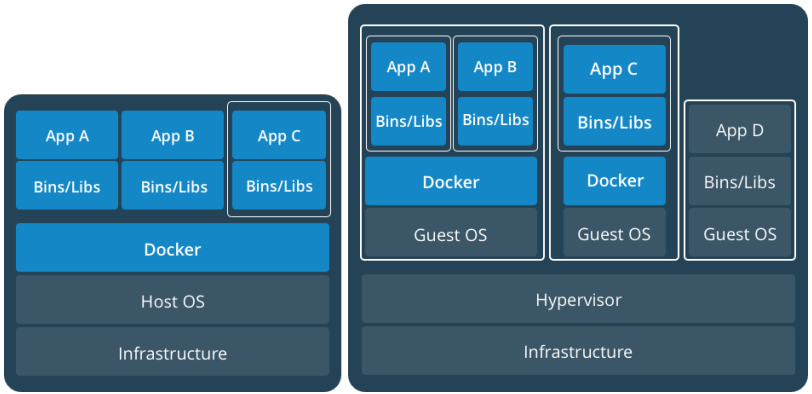
- Easily misconceptualised
- Fundamentally different architectures

Docker Containers Versus Virtual Machines



Virtual Machines

Docker Containers



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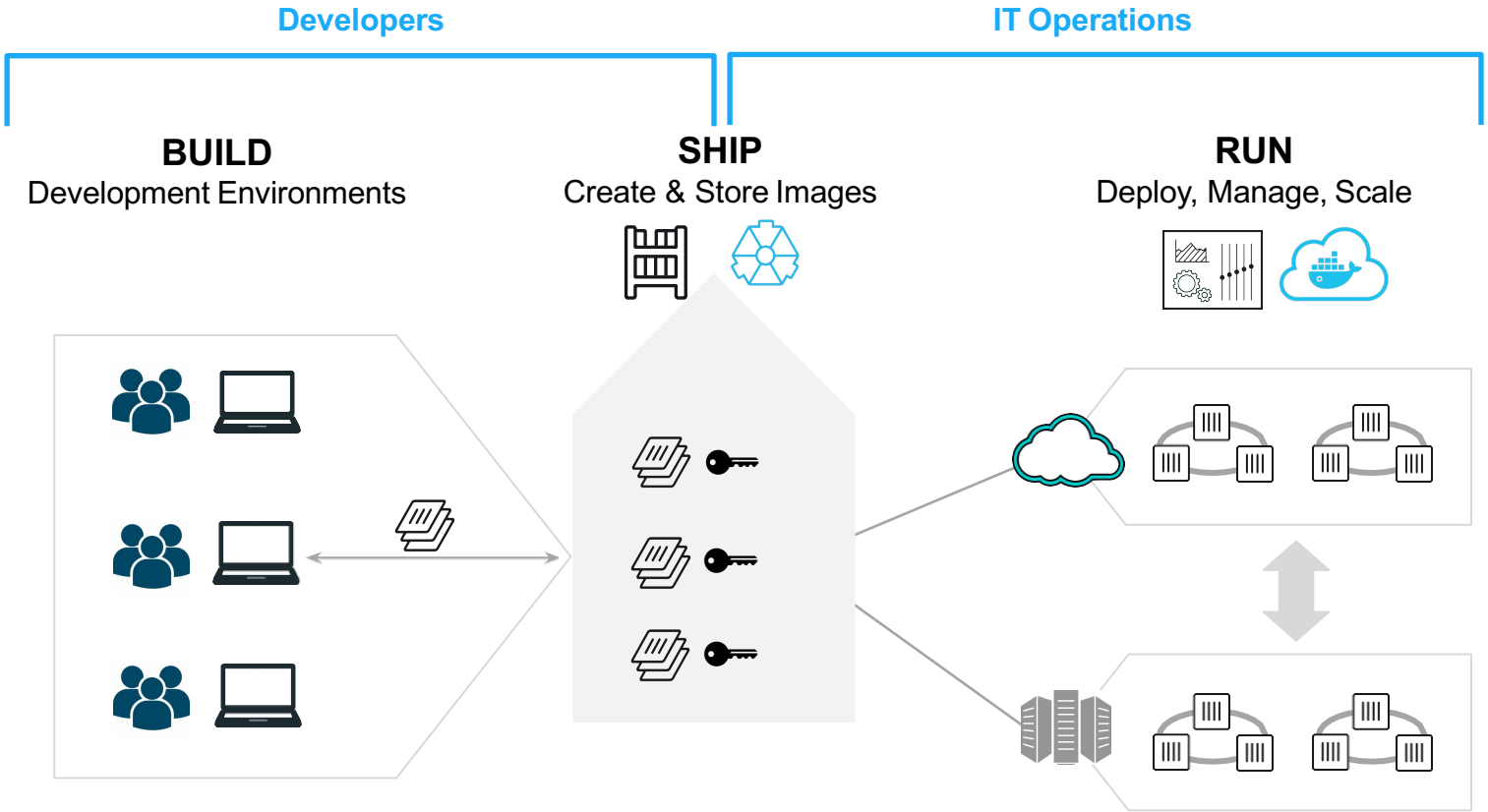
Using Docker: Build, Ship, Run Workflow



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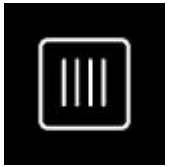
Some Docker vocabulary

Docker Image

The basis of a Docker container. Represents a full application



Docker Container

The standard unit in which the application service resides and executes

Docker Engine

Creates, ships and runs Docker containers deployable on a physical or virtual, host locally, in a datacenter or cloud service provider

Registry Service (Docker Hub(Public) or Docker Trusted Registry(Private))

Cloud or server based storage and distribution service for your images

Basic Docker Commands

```
$ docker image pull node:latest

$ docker image ls
$ docker container run –d –p 5000:5000 --name node node:latest

$ docker container ps


$ docker container stop node(or <container id>)

$ docker container rm node (or <container id>)

$ docker image rmi (or <image id>)

$ docker build –t node:2.0 .

$ docker image push node:2.0

$ docker --help
```

docker

Docker Build Cache Gotcha

- Sometimes you will change your Dockerfile and do a build and yet your container image will not change.
- This is because of the docker **cache** – when you do a docker build it trys to intelligently cache the layers such that it only rebuilds the minimum number of layers.
- You can override this behavior by doing:
  - **docker build –t <image-name> . --no-cache**
- You can also avoid this by deleting the container image and then rebuilding it, but it is likely more convenient for you to use the no-cache option in docker build shown above.

- Sometimes you may also need to delete the image and completely regenerate.
  - You can remove all unused images with **docker image prune -a**

Docker Build Args Gotcha

- You can pass build

Dockerfile – Linux Example

Dockerfile

```
# Create image based on the official Node 6 image from dockerhub
FROM node:latest

# Create a directory where our app will be placed
RUN mkdir -p /usr/src/app

# Change directory so that our commands run inside this new directory
WORKDIR /usr/src/app

# Copy dependency definitions
COPY package.json /usr/src/app

# Install dependecies
RUN npm install

# Get all the code needed to run the app
COPY . /usr/src/app

# Expose the port the app runs in
EXPOSE 4200

# Serve the app
CMD ["npm", "start"]
```

- Instructions on how to build a Docker image
- Looks very similar to “native” commands
- Important to optimize your Dockerfile

- Dockerizing a Node.js web app

Section 2:
Anatomy of a Docker

Let’s Go Back to Our Dockerfile

Dockerfile

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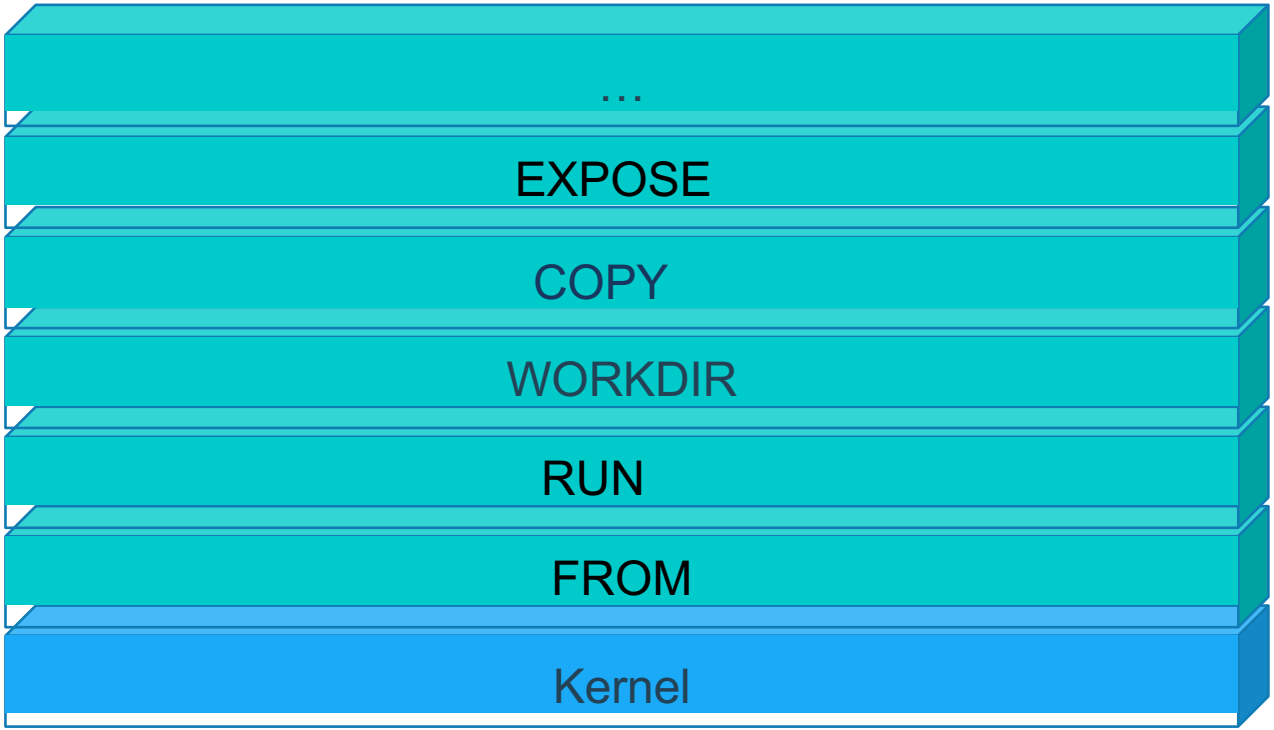
```

Each Dockerfile Command Creates a Layer

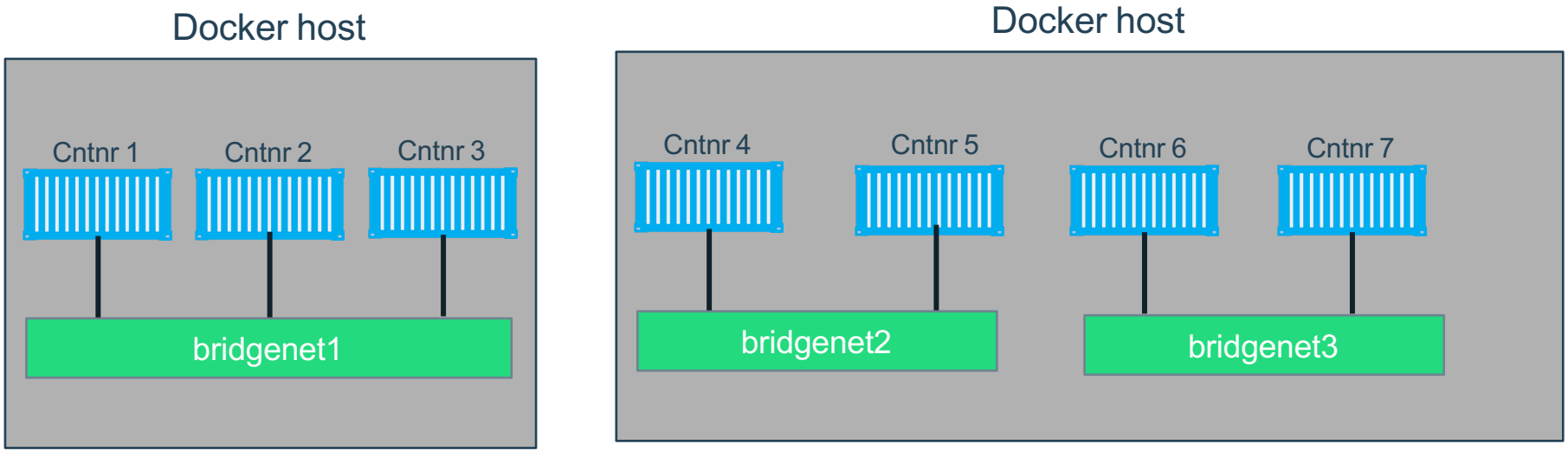


Docker Image Pull: Pulls Layers

```
Alexander@DESKTOP-90ATKET MINGW64 ~/Docker/Demo
$ docker pull nginx:latest
latest: Pulling from library/nginx
bc95e04b23c0: Pull complete
f3186e650f4e: Pull complete
9ac7d6621708: Pull complete
Digest: sha256:b81f317384d7388708a498555c28a7cce778a8f291d90021208b3eba3fe74887
Status: Downloaded newer image for nginx:latest
```

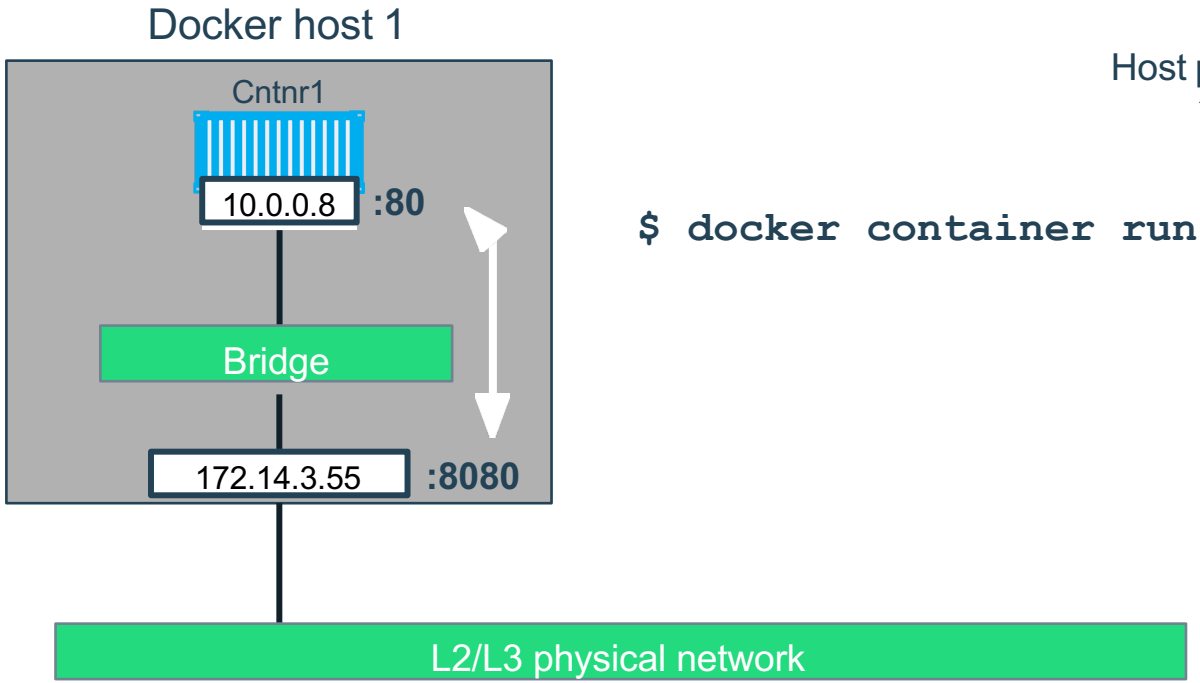
Section 3:
Networking

What is Docker Bridge Networking




```
docker network create -d bridge --name bridgenet1
```

Docker Bridge Networking and Port Mapping



Host port

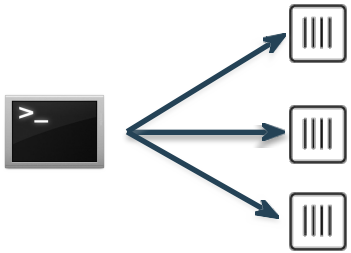
Container port

```
$ docker container run -p 8080:80 ...
```

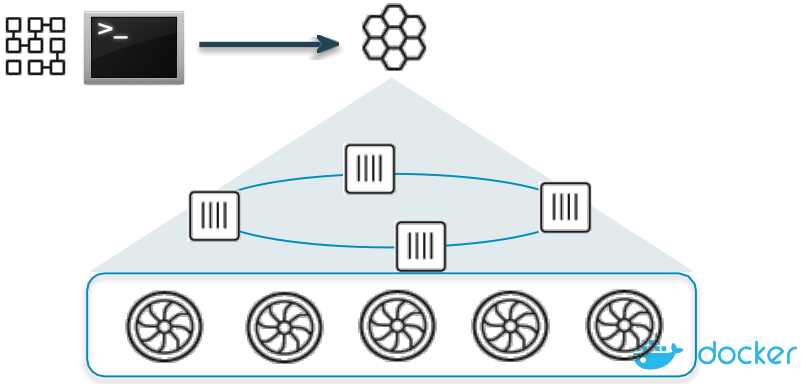
Section 4:
Docker Compose

Docker Compose: Multi Container Applications

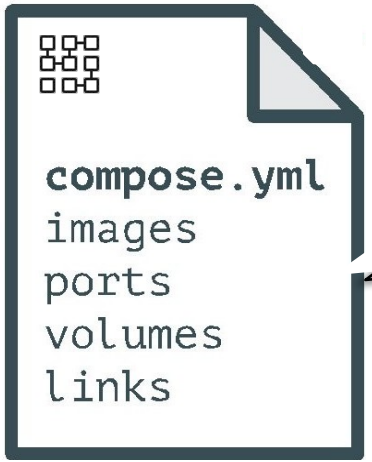
- Build and run one container at a time
- Manually connect containers together
- Must be careful with dependencies and start up order



- Define multi container app in compose.yml file
- Single command to deploy entire app
- Handles container dependencies
- Works with Docker Swarm, Networking, Volumes, Universal Control Plane



Docker Compose: Multi Container Applications




```
version: '2' # specify docker-compose version

# Define the services/containers to be run
services:
angular: # name of the first service
build: client # specify the directory of the Dockerfile
ports:
- "4200:4200" # specify port forwarding

express: #name of the second service
build: api # specify the directory of the Dockerfile
ports:
- "3977:3977" #specify ports forwarding

database: # name of the third service
image: mongo # specify image to build container from
ports:
- "27017:27017" # specify port forwarding
```

docker

Docker Compose Networking

- By default, docker compose will put all of the **services** specified in your compose.yml file will be put on a docker network together.
- This allows you to access the other containers in the network via their name in the compose.yml file.
- If you have one service named **server** and another service named **database**
  - Suppose database exposes port 5001 to access the database
  - In the server container you can use **database:5001** to access it across the network
- Helpful Tip: The server container may take some time to

Docker Compose Networking

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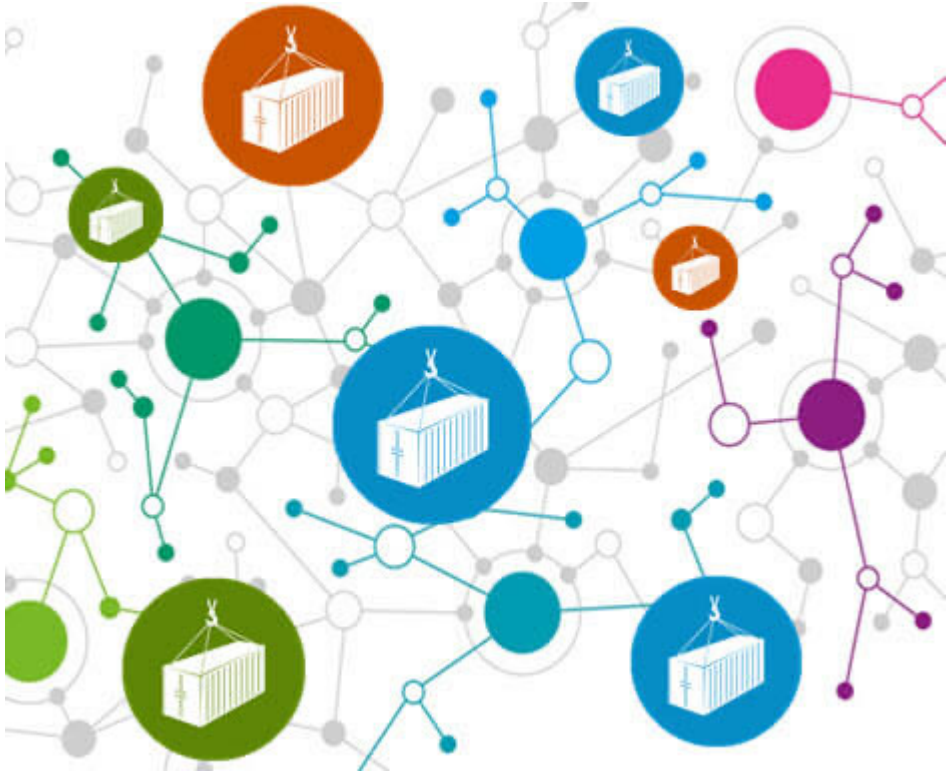
Docker Compose: Scale Container Applications



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Python Server

To run Python server-side code, you'll need to use a Python web framework. Flask is a good lightweight web framework.

To run this you'll need to install Python/PIP, then install Flask using pip3 install flask. (This should be done using the Requirements.txt and docker file)

At this point you should be able to run the Python Flask examples using for example python3 python-example.py, then navigating to localhost:5000 in your browser.

Python Flask Server Example

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Python Client

To run Python Client-side code, you'll need to use requests framework.
This is included by importing the urllib.req

Then you need to listen the port you have exposed from the server

Read the content from the port, print the values and close the connection.

docker