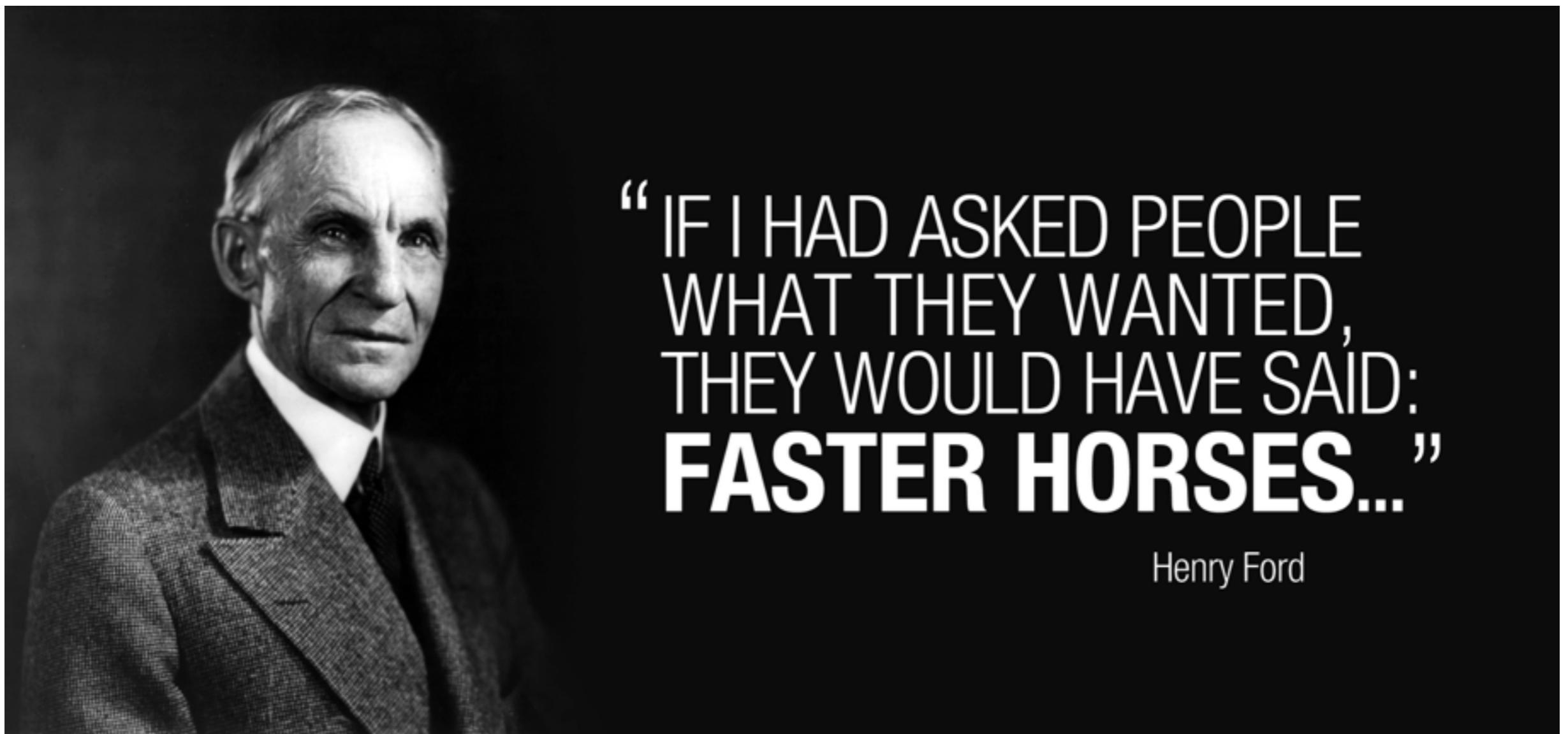


Docker 101



Arun Gupta, @arungupta
Red Hat

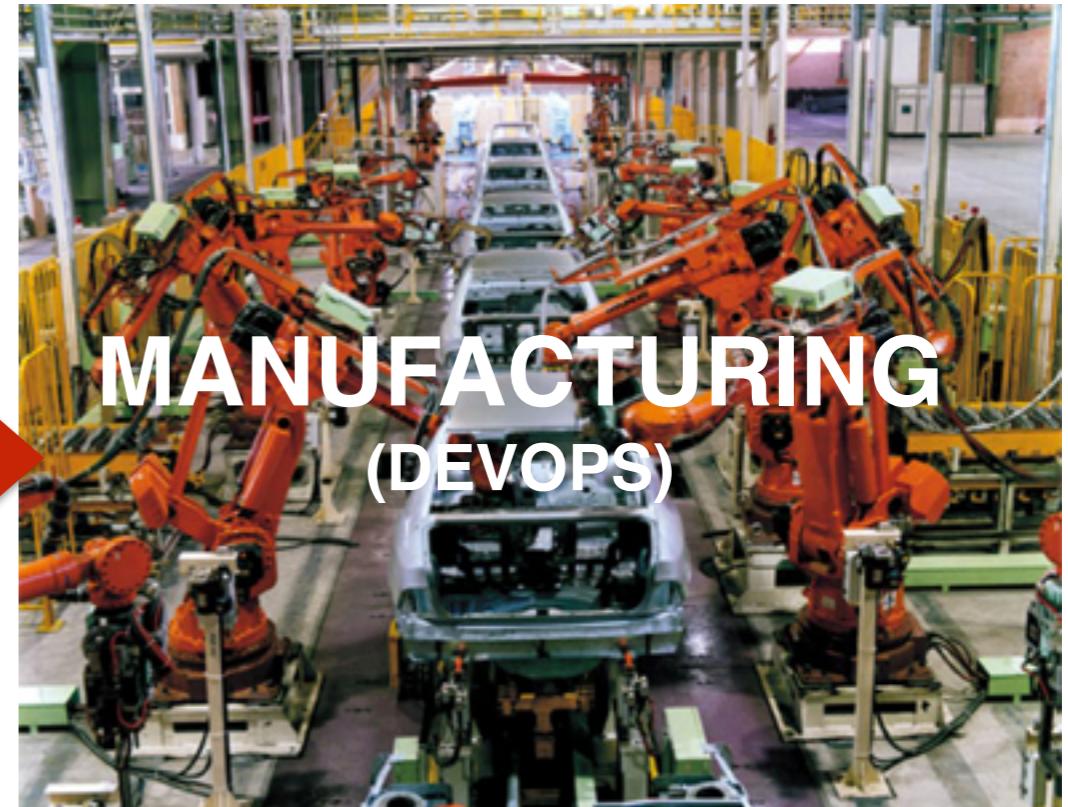


“IF I HAD ASKED PEOPLE
WHAT THEY WANTED,
THEY WOULD HAVE SAID:
FASTER HORSES...”

Henry Ford



CRAFTWORK



MANUFACTURING
(DEVOPS)



WORKSHOP



FACTORY
(CLOUD)

Advantages

Standardization



ISO standard (modes and equipment). Unique identification number and size type code.

Flexibility



Commodities, manufactured goods, liquids and refrigerated goods.

Costs



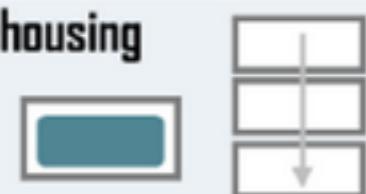
Low transport costs. Economies of scale at modes and terminals.

Velocity



Fast transshipment operations. Low terminal turnaround times.

Warehousing



Own warehouse; simpler and less expensive packaging. Stacking capability.

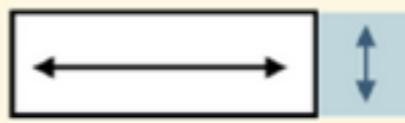
Security & Safety



Contents unknown to carriers. Reduced spoilage and losses.

Drawbacks

Site Constraints



Large consumption of terminal space. Draft issues with larger containerships.

Capital Intensiveness



Container handling infrastructures and equipment are important investments.

Stacking



Complexity of arrangement of containers, both on the ground and on modes.

Repositioning



Divergence between production and consumption; repositioning. 20% of all containers.

Theft and Losses



High value goods vulnerable to thefts, particularly between terminal and final destination.

Illicit Trade

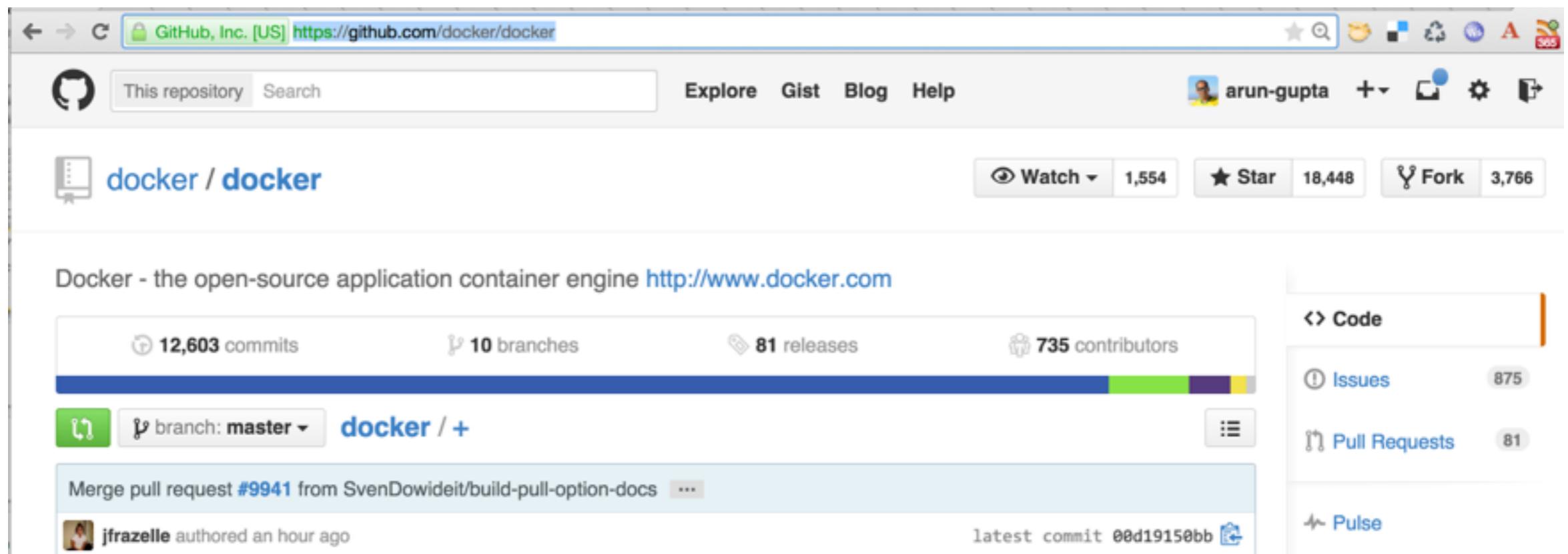


Illicit trade of goods, drugs and weapons, as well as for illegal immigration.

What is Docker?

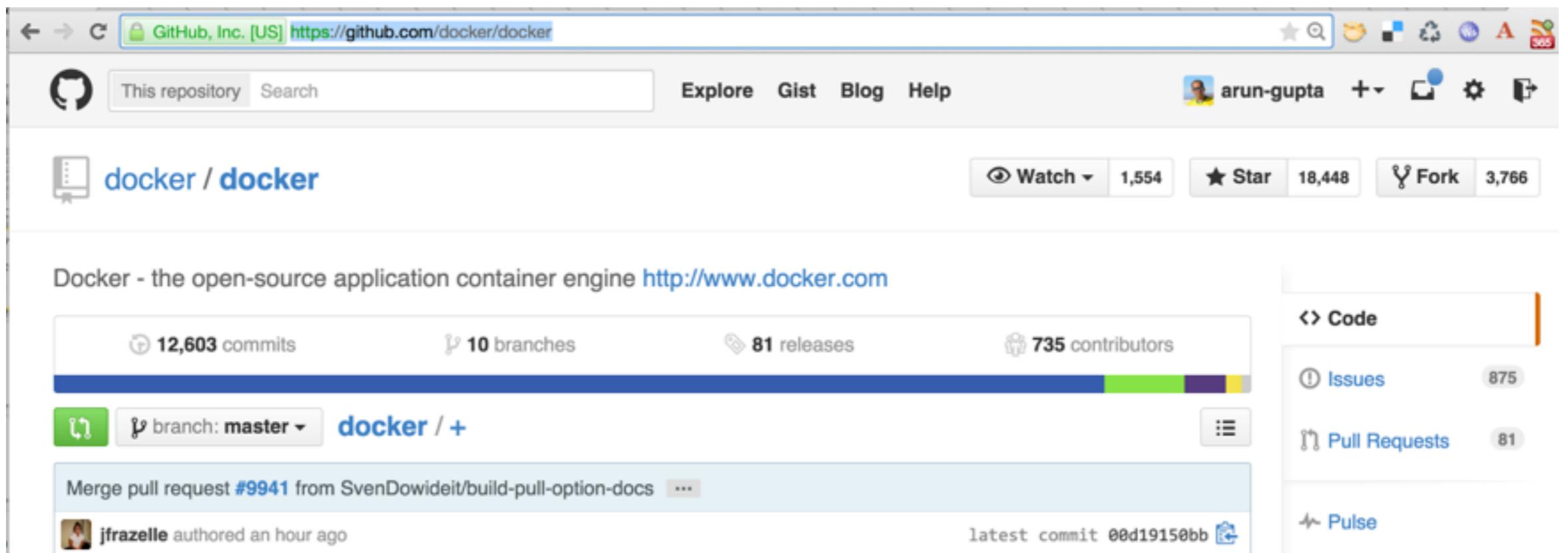
What is Docker?

- Open source project and company



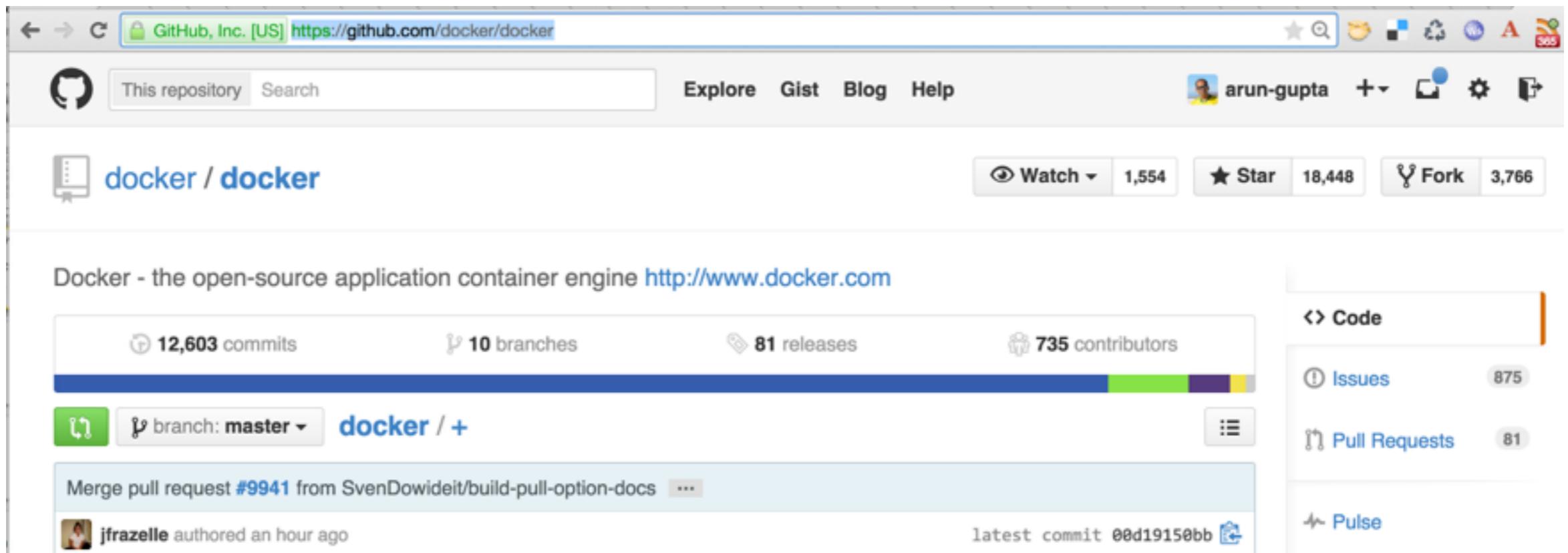
What is Docker?

- Open source project and company
- Used to create containers for software applications



What is Docker?

- Open source project and company
- Used to create containers for software applications
- Package Once Deploy Anywhere (PODA)



Advantages

Advantages

- Isolation

Advantages

- Isolation
- Portability - “it works on my machine”

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox
- Limit resource usage

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox
- Limit resource usage
- Lightweight footprint and minimal overhead

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox
- Limit resource usage
- Lightweight footprint and minimal overhead
- Simplified dependency

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox
- Limit resource usage
- Lightweight footprint and minimal overhead
- Simplified dependency
- Sharing

Advantages

- Isolation
- Portability - “it works on my machine”
- Snapshotting - Upgrade/downgrade application versions
- Security sandbox
- Limit resource usage
- Lightweight footprint and minimal overhead
- Simplified dependency
- Sharing
- Faster Deployments

Underlying Technology

Underlying Technology

- Written in Go

Underlying Technology

- Written in Go
- Uses several Linux features

Underlying Technology

- Written in Go
- Uses several Linux features
 - **Namespaces** to provide isolation

Underlying Technology

- Written in Go
- Uses several Linux features
 - **Namespaces** to provide isolation
 - **Control groups** to share/limit hardware resources

Underlying Technology

- Written in Go
- Uses several Linux features
 - **Namespaces** to provide isolation
 - **Control groups** to share/limit hardware resources
 - **Union File System** makes it light and fast

Underlying Technology

- Written in Go
- Uses several Linux features
 - **Namespaces** to provide isolation
 - **Control groups** to share/limit hardware resources
 - **Union File System** makes it light and fast
 - **libcontainer** defines container format

Is it only Linux?

Is it only Linux?

- Natively supported in Linux

Is it only Linux?

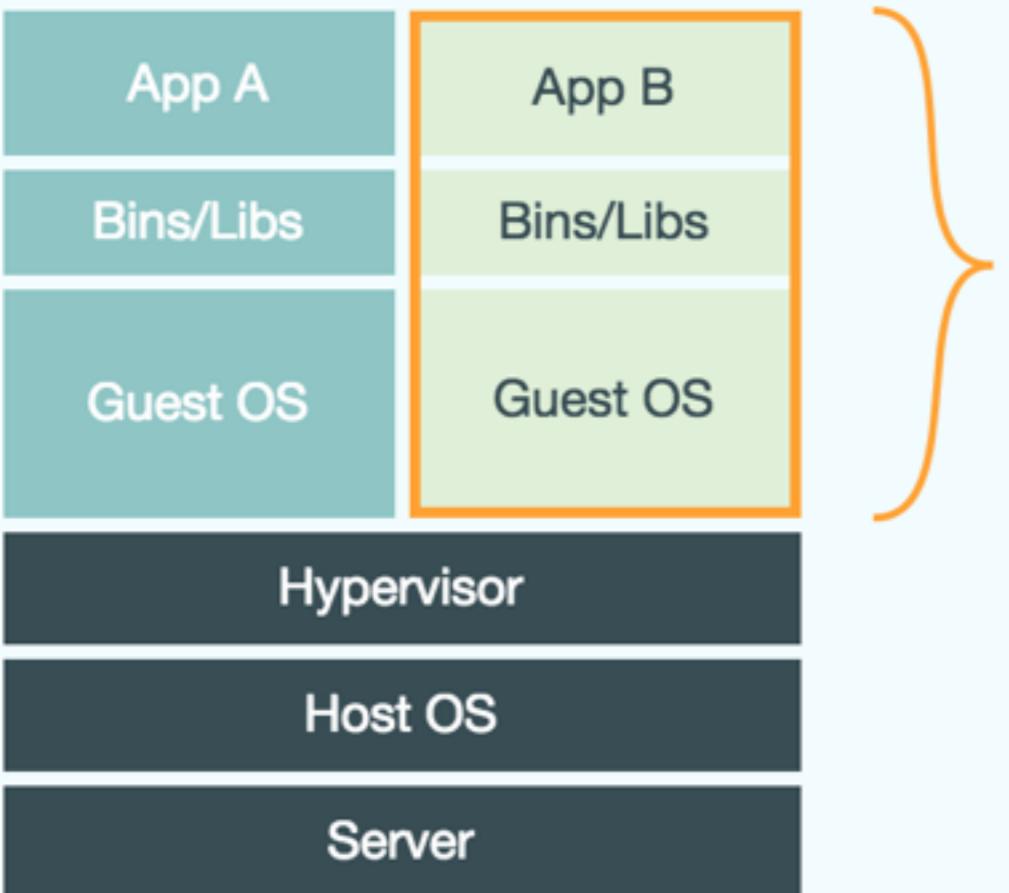
- Natively supported in Linux
- Can be installed on Mac or Windows using boot2docker



Is it only Linux?

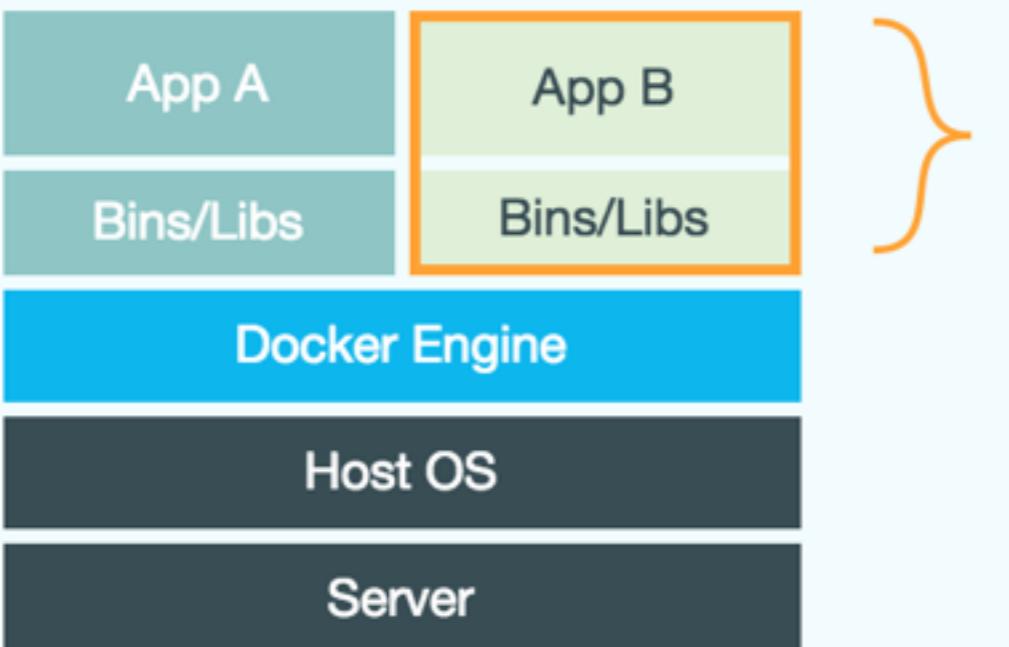
- Natively supported in Linux
- Can be installed on Mac or Windows using boot2docker
 - Tiny Core Linux VM





Virtual Machines

Each virtualized application includes not only the application - which may be only 10s of MB - and the necessary binaries and libraries, but also an entire guest operating system - which may weigh 10s of GB.



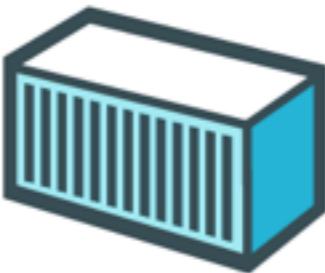
Docker

The Docker Engine container comprises just the application and its dependencies. It runs as an isolated process in userspace on the host operating system, sharing the kernel with other containers. Thus, it enjoys the resource isolation and allocation benefits of VMs but is much more portable and efficient.



Build

Develop an app using Docker containers with
any language and any toolchain.



Ship

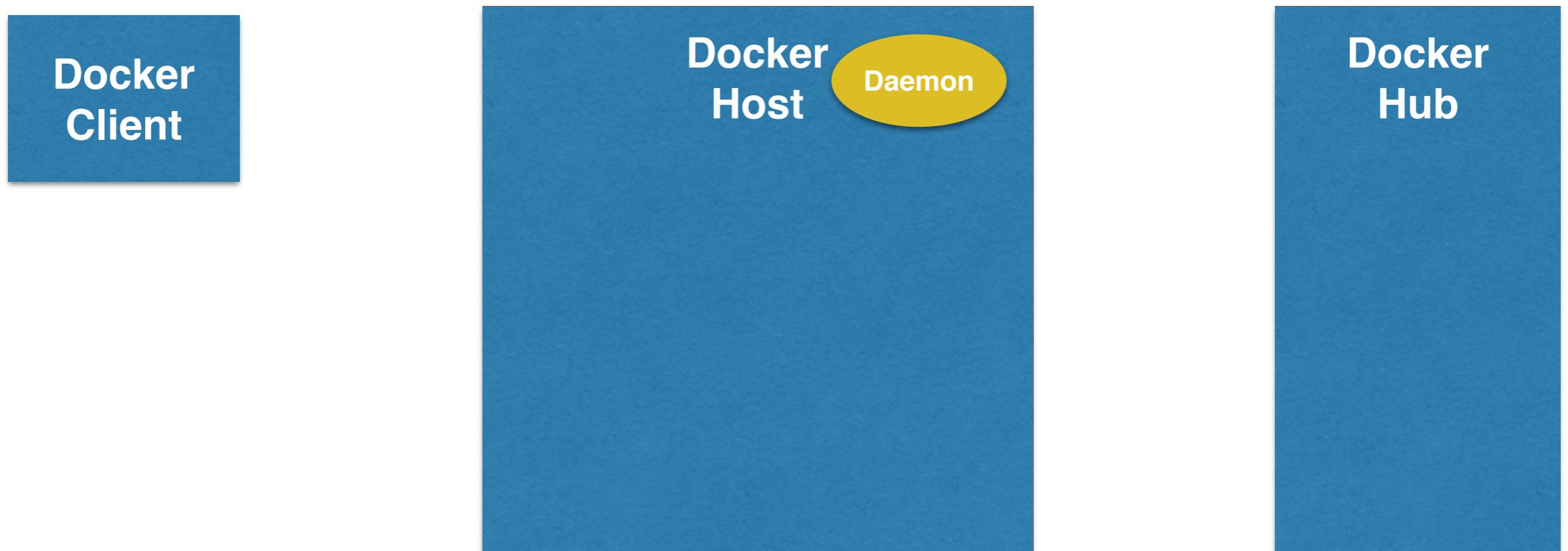
Ship the “Dockerized” app and dependencies
anywhere - to QA, teammates, or the cloud -
without breaking anything.



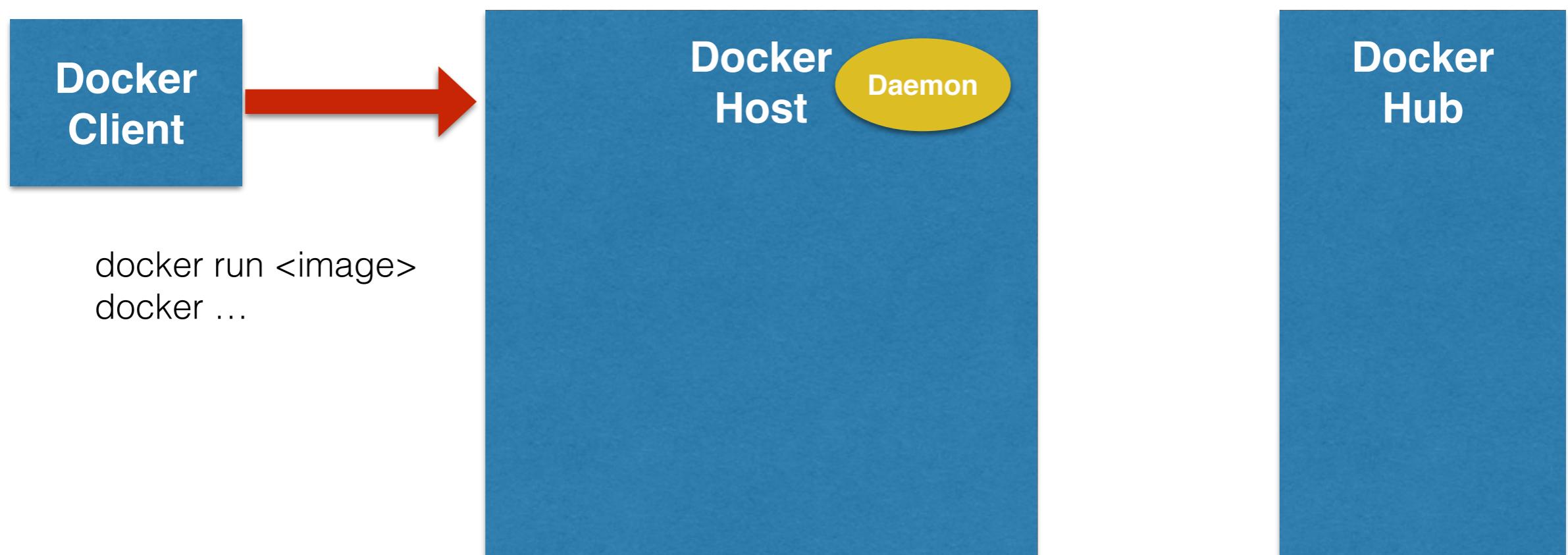
Run

Scale to 1000s of nodes, move between data
centers and clouds, update with zero
downtime and more.

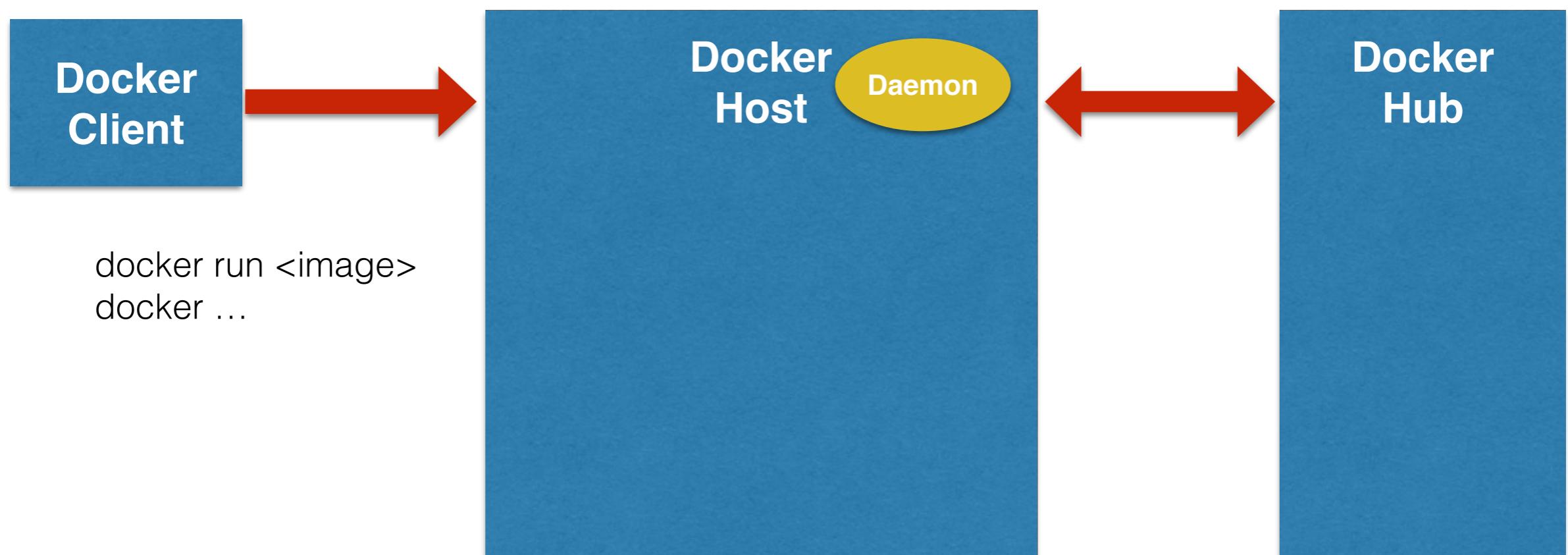
Docker Workflow



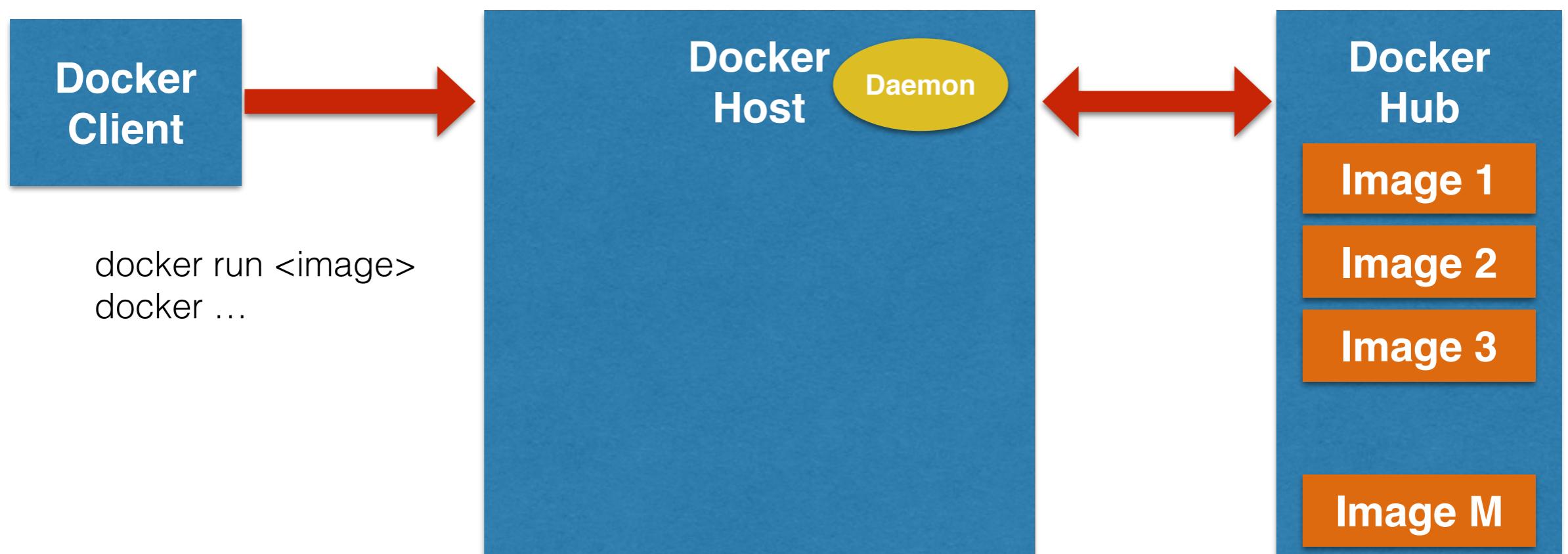
Docker Workflow



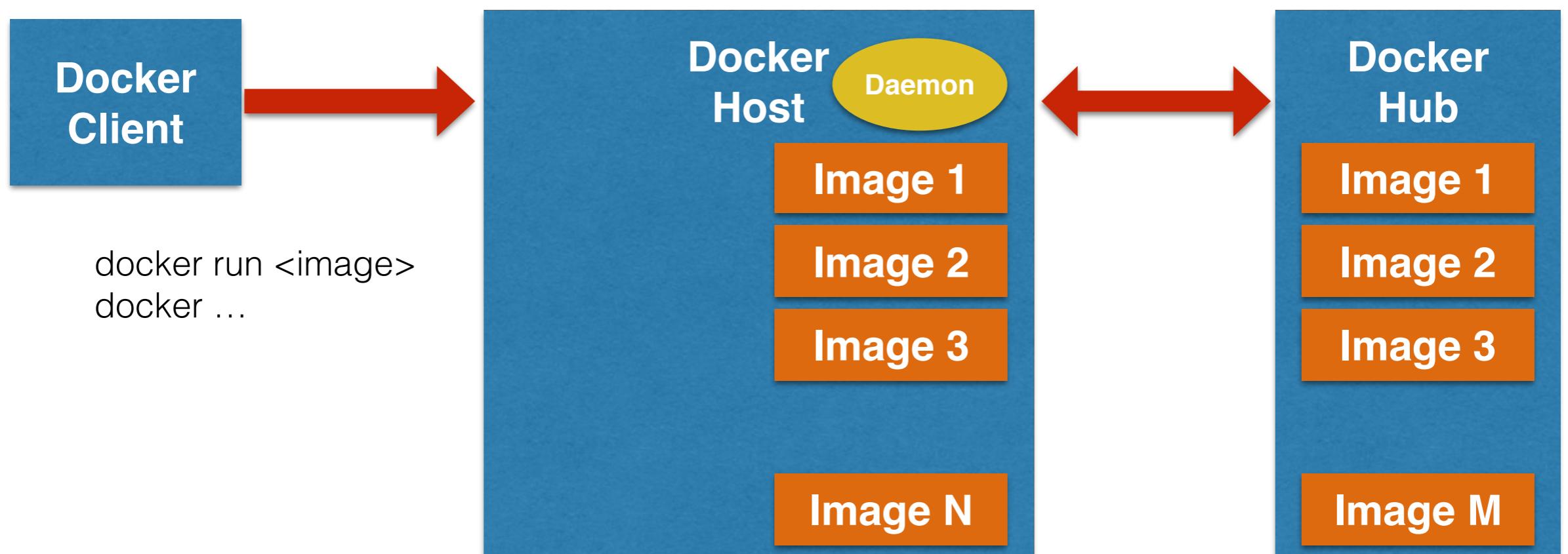
Docker Workflow



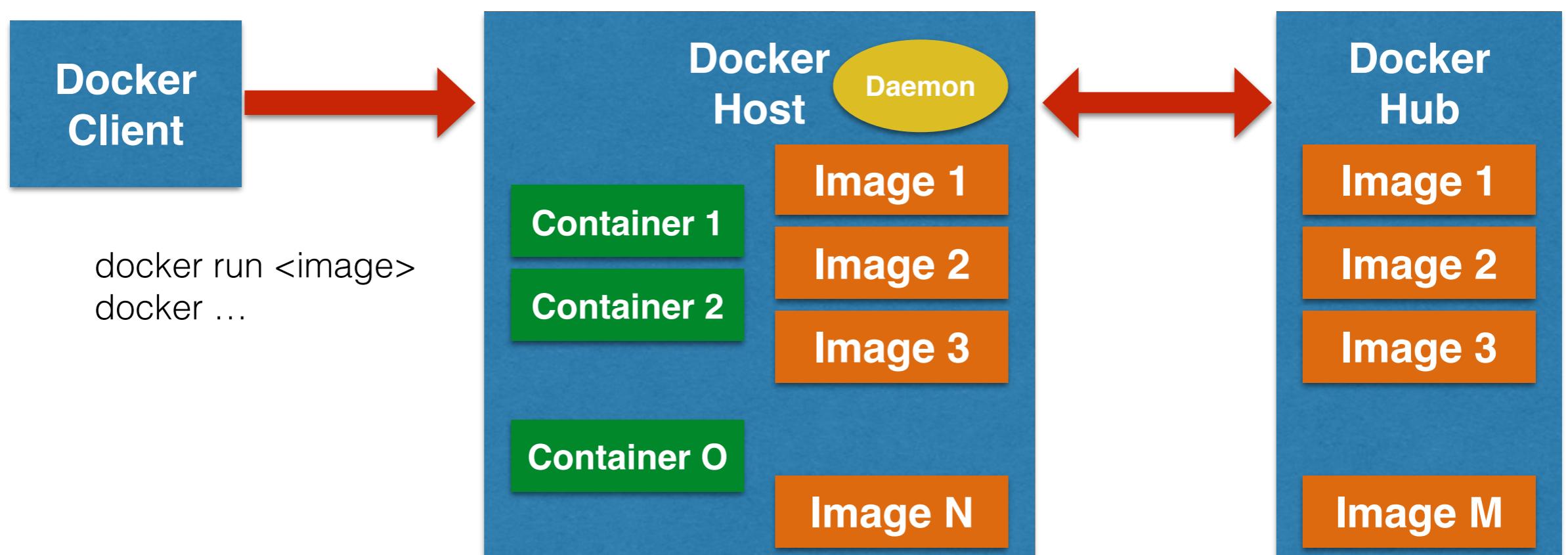
Docker Workflow



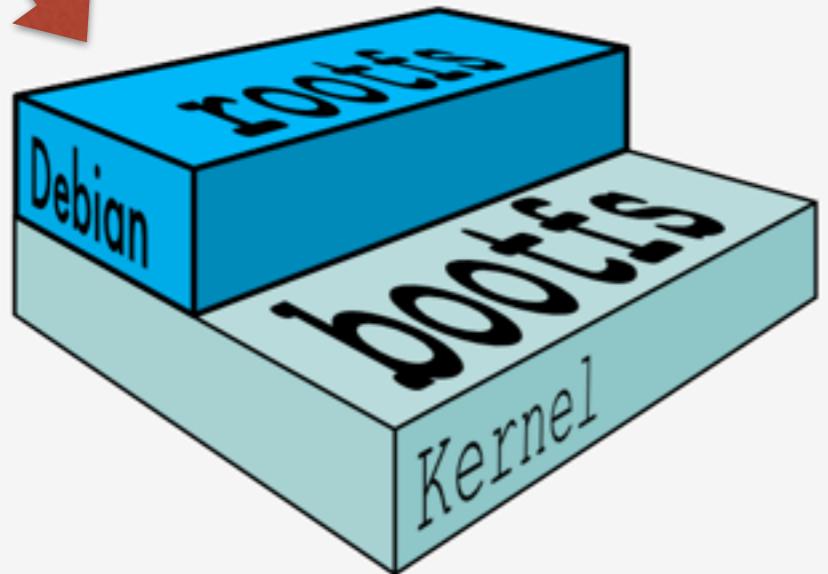
Docker Workflow



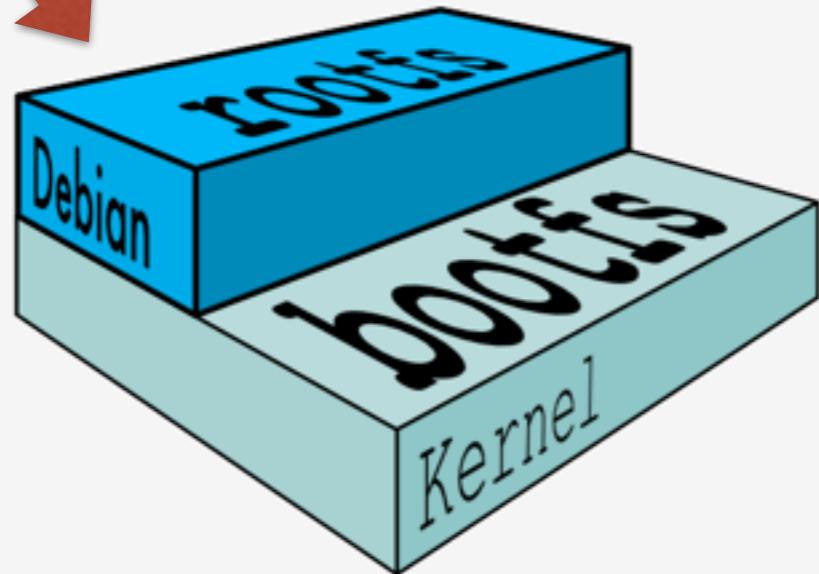
Docker Workflow



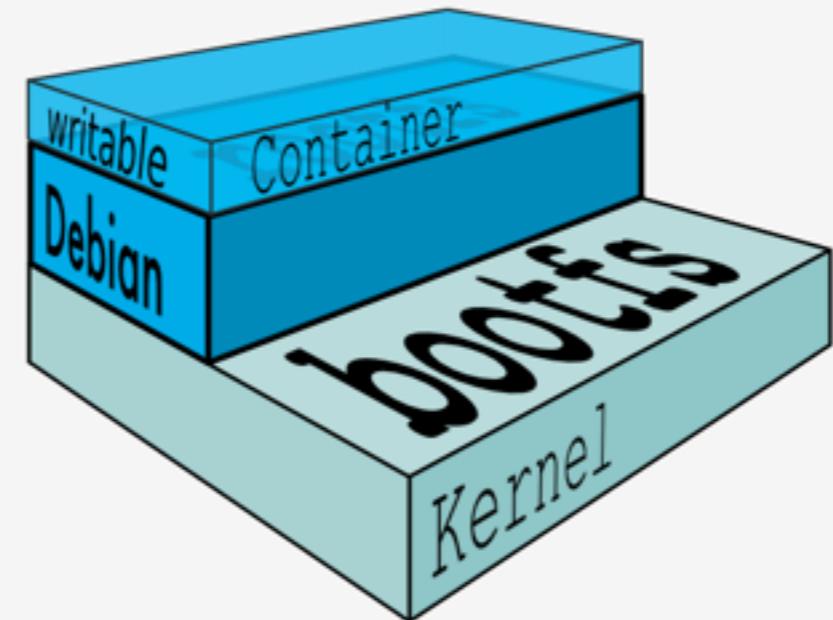
read-only



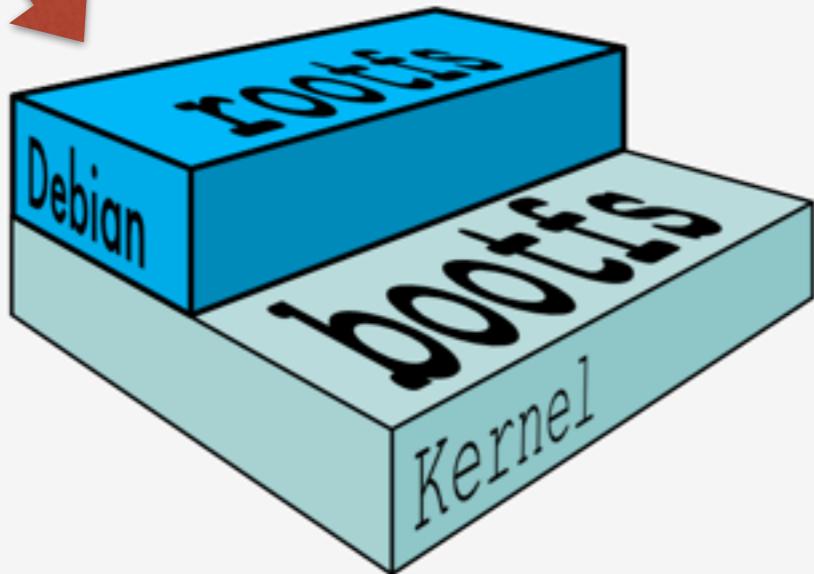
read-only



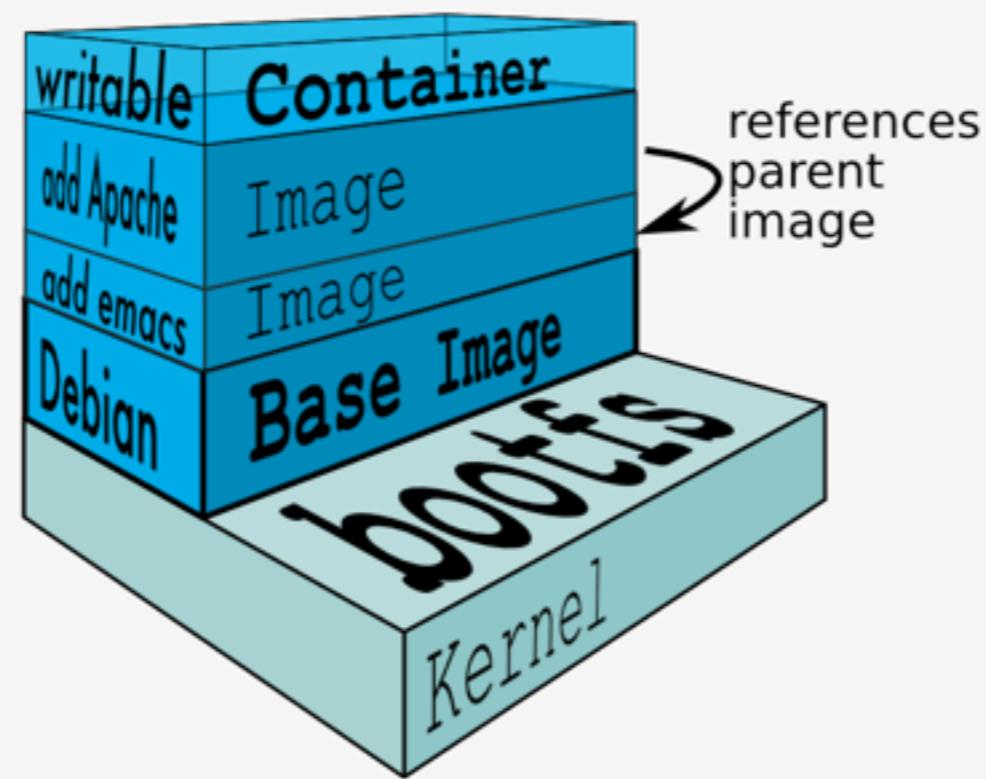
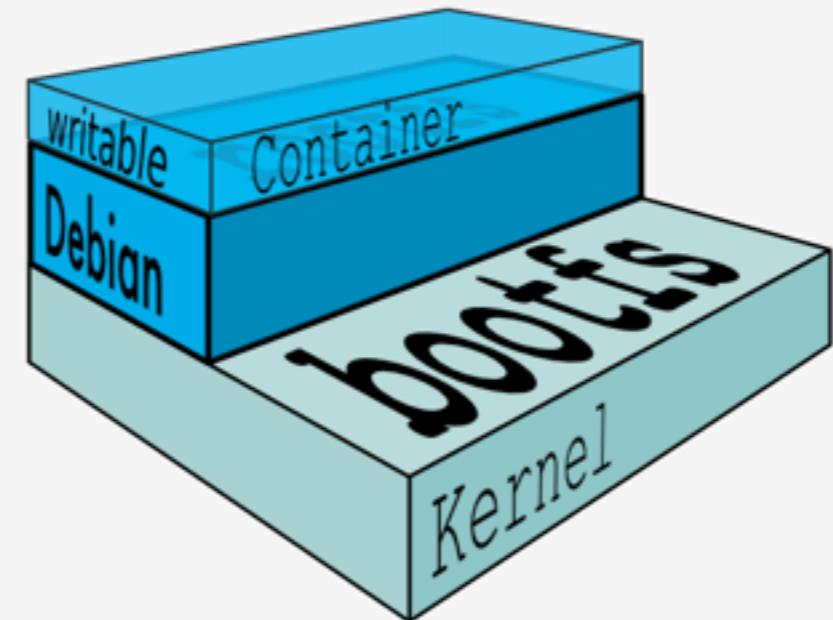
Union File System



read-only



Union File System





Build

Develop an app using Docker containers with
any language and any toolchain.



- Image defined in text-based **Dockerfile**

Develop an app using Docker containers with
any language and any toolchain.



Develop an app using Docker containers with
any language and any toolchain.

- Image defined in text-based **Dockerfile**
- List of commands to build the image



Build

Develop an app using Docker containers with
any language and any toolchain.

- Image defined in text-based **Dockerfile**
- List of commands to build the image

```
FROM fedora:latest

CMD echo "Hello world"
```



Build

Develop an app using Docker containers with
any language and any toolchain.

- Image defined in text-based **Dockerfile**
- List of commands to build the image

```
FROM fedora:latest

CMD echo "Hello world"
```

```
FROM jboss/wildfly
MAINTAINER Arun Gupta <arungupta@redhat.com>

RUN curl -L https://github.com/javaee-samples/javaee7-hol/raw/master/solution/
movieplex7-1.0-SNAPSHOT.war -o /opt/jboss/wildfly/standalone/deployments/
movieplex7-1.0-SNAPSHOT.war
```



Build

Develop an app using Docker containers with
any language and any toolchain.

- Image defined in text-based **Dockerfile**
- List of commands to build the image
- `docker build` or `pull`

```
FROM fedora:latest
```

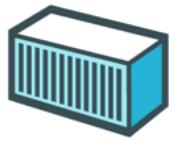
```
CMD echo "Hello world"
```

```
FROM jboss/wildfly
MAINTAINER Arun Gupta <arungupta@redhat.com>
```

```
RUN curl -L https://github.com/javaee-samples/javaee7-hol/raw/master/solution/
movieplex7-1.0-SNAPSHOT.war -o /opt/jboss/wildfly/standalone/deployments/
movieplex7-1.0-SNAPSHOT.war
```

```
1 FROM centos
2 MAINTAINER Arun Gupta <arungupta@redhat.com>
3
4 # Execute system update
5 RUN yum -y update && yum clean all
6
7 # Install packages necessary to run EAP
8 RUN yum -y install xmlstarlet saxon augeas bsdtar unzip && yum clean all
9
10 # Create a user and group used to launch processes
11 # The user ID 1000 is the default for the first "regular" user on Fedora/RHEL,
12 # so there is a high chance that this ID will be equal to the current user
13 # making it easier to use volumes (no permission issues)
14 RUN groupadd -r jboss -g 1000 && useradd -u 1000 -r -g jboss -m -d /opt/jboss -s /sbin/nologin -c "JBoss user" jboss
15
16 # Set the working directory to jboss' user home directory
17 WORKDIR /opt/jboss
18
19 # User root user to install software
20 USER root
21
22 # Install necessary packages
23 RUN yum -y install java-1.7.0-openjdk-devel && yum clean all
24 #RUN yum -y install java-1.8.0-openjdk-devel && yum clean all
25
26 # Switch back to jboss user
27 USER jboss
28
29 # Set the JAVA_HOME variable to make it clear where Java is located
30 ENV JAVA_HOME /usr/lib/jvm/java
31
32 # Set the WILDFLY_VERSION env variable
33 ENV WILDFLY_VERSION 8.2.0.Final
34
35 # Add the WildFly distribution to /opt, and make wildfly the owner of the extracted tar content
36 # Make sure the distribution is available from a well-known place
37 RUN cd $HOME && curl -O http://download.jboss.org/wildfly/$WILDFLY_VERSION/wildfly-$WILDFLY_VERSION.zip && unzip wildfly-$WILDFLY_
38
39 # Set the JBOSS_HOME env variable
40 ENV JBOSS_HOME /opt/jboss/wildfly
41
42 # Expose the ports we're interested in
43 EXPOSE 8080 9990
44
45 # Set the default command to run on boot
46 # This will boot WildFly in the standalone mode and bind to all interface
47 CMD ["/opt/jboss/wildfly/bin/standalone.sh", "-c", "standalone-full.xml", "-b", "0.0.0.0"]
```

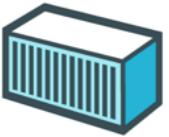




Ship

Ship the “Dockerized” app and dependencies anywhere - to QA, teammates, or the cloud - without breaking anything.

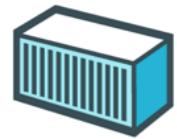
- Images shared using registry



Ship

Ship the “Dockerized” app and dependencies anywhere - to QA, teammates, or the cloud - without breaking anything.

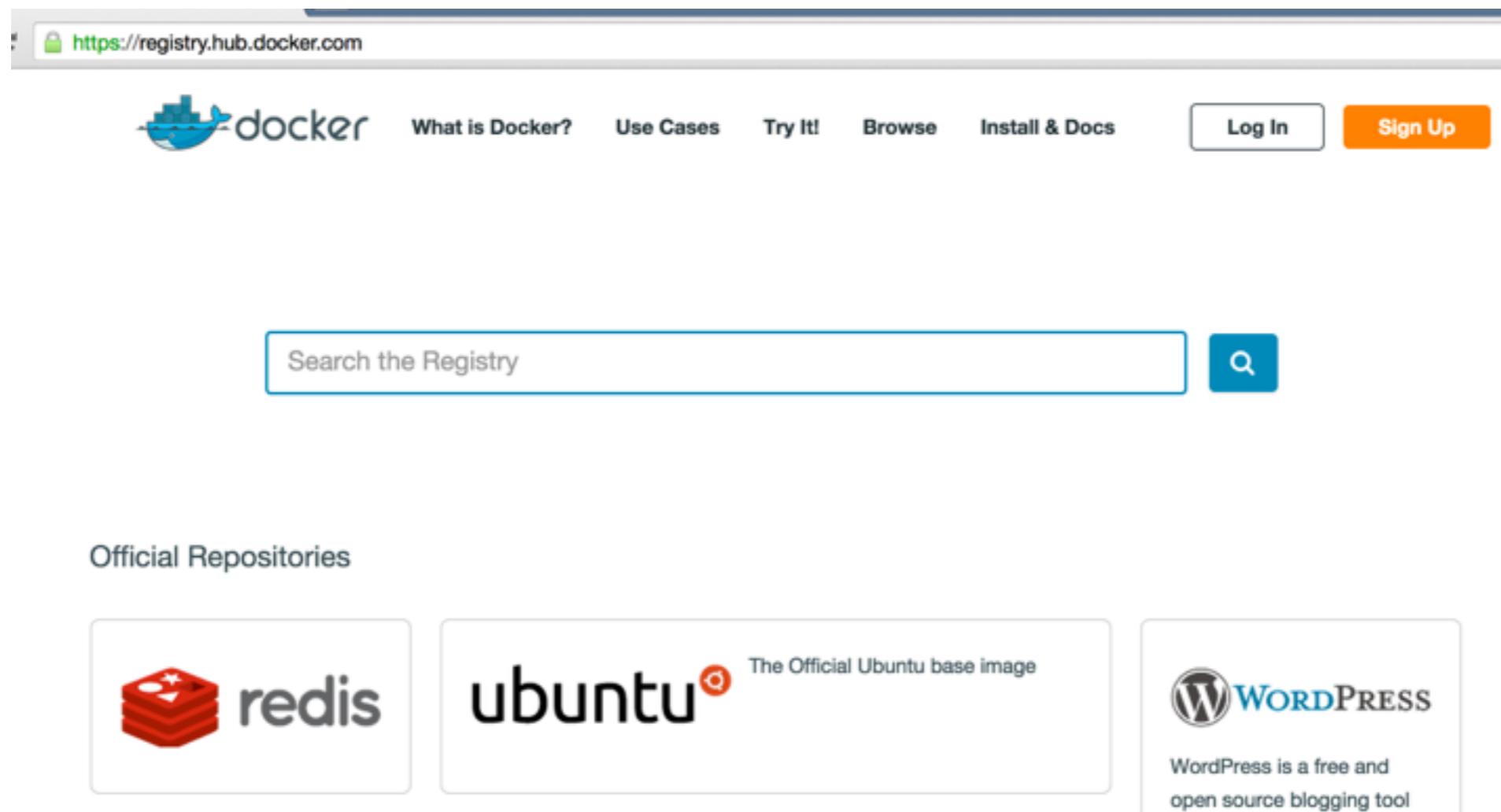
- Images shared using registry



Ship

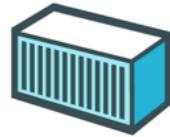
- Docker Hub is public SaaS

Ship the “Dockerized” app and dependencies anywhere - to QA, teammates, or the cloud - without breaking anything.



The screenshot shows the Docker Hub Registry homepage. At the top, there's a navigation bar with links for "What is Docker?", "Use Cases", "Try It!", "Browse", "Install & Docs", "Log In", and "Sign Up". Below the navigation is a search bar with the placeholder "Search the Registry" and a magnifying glass icon. The main content area is titled "Official Repositories" and features three cards: 1) "redis" with its logo, 2) "ubuntu" with the text "The Official Ubuntu base image", and 3) "WORDPRESS" with the text "WordPress is a free and open source blogging tool".

- Images shared using registry
- Docker Hub is public SaaS
- Private registries can be setup inside firewall

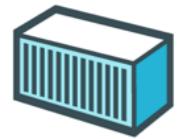


Ship

Ship the “Dockerized” app and dependencies anywhere - to QA, teammates, or the cloud - without breaking anything.

The screenshot shows the Docker Hub homepage at <https://registry.hub.docker.com>. The top navigation bar includes links for "What is Docker?", "Use Cases", "Try It!", "Browse", "Install & Docs", "Log In", and "Sign Up". A search bar at the top right contains the placeholder "Search the Registry" and a magnifying glass icon. Below the search bar, the heading "Official Repositories" is displayed. Three repository cards are visible: "redis" (with a red cube icon), "ubuntu" (with a black "ubuntu" logo and the text "The Official Ubuntu base image"), and "WORDPRESS" (with a white "W" icon and the text "WordPress is a free and open source blogging tool").

- Images shared using registry



Ship

- Docker Hub is public SaaS

Ship the “Dockerized” app and dependencies anywhere - to QA, teammates, or the cloud - without breaking anything.

- Private registries can be setup inside firewall

- `docker push` or `pull`

The screenshot shows the Docker Hub homepage at <https://registry.hub.docker.com>. The top navigation bar includes links for "What is Docker?", "Use Cases", "Try It!", "Browse", "Install & Docs", "Log In", and "Sign Up". Below the navigation is a search bar with the placeholder "Search the Registry" and a magnifying glass icon. The main content area is titled "Official Repositories" and features three cards: "redis" with its logo, "ubuntu" with the text "The Official Ubuntu base image", and "WORDPRESS" with its logo and the text "WordPress is a free and open source blogging tool".



Run

Scale to 1000s of nodes, move between data
centers and clouds, update with zero
downtime and more.

- Container built from image



Run

Scale to 1000s of nodes, move between data centers and clouds, update with zero downtime and more.

- Container built from image
- Runtime representation of image



Run

Scale to 1000s of nodes, move between data centers and clouds, update with zero downtime and more.



- Container built from image
- Runtime representation of image
- Self contained execution environment

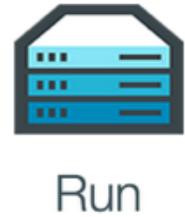


Run

Scale to 1000s of nodes, move between data centers and clouds, update with zero downtime and more.



- Container built from image
- Runtime representation of image
- Self contained execution environment
- `docker run`



Scale to 1000s of nodes, move between data centers and clouds, update with zero downtime and more.



Docker commands

- **docker ps**: List running containers
- **docker stop**: Stop a running container
- **docker rm**: Remove a running container
- **docker rmi**: Remove an image
- ...

<https://docs.docker.com/reference/commandline/cli/>

DOCKER ECOSYSTEM

YEAR IN REVIEW 2014



\$15
million

JAN 21
DOCKER CLOSES
\$15M FUNDING

Series B round of funding led by
Greylock Partners

v0.9

MAR 10
DOCKER 0.9

Drops LXC and replaces it with
libcontainer library written in Go

MAR 15
WAVEMAKER PREVIEWS
DOCKER-ARCHITECTED CLOUD

Developer preview of Wavemaker Cloud.
Provisions 5k+ instances to 500+ developers
in over 50 countries

1st
birthday

MAR 20
DOCKER TURNS ONE

370 contributors,
1 million downloads,
27 countries



dockercon14

June 9-10, 2014 • San Francisco



GOOGLE ANNOUNCES
KUBERNETES

An open source orchestration system for
Docker containers. Receives support from
Microsoft, IBM, Docker, CoreOS and others

v1.0

DOCKER 1.0 AND
ENTERPRISE SUPPORT

Availability of commercial support,
integration with Docker Hub



ADDITIONAL
LAUNCHES

libnetwork: network services toolkit
libcontainer: ultra-lightweight networking library
libcontainer: standard interface to Linux OS
sandboxing, made a standalone project



APR 23
AWS LAUNCHES
SUPPORT FOR DOCKER

AWS Elastic Beanstalk supports running
and managing dockerized applications



APR 15
RED HAT FAST-TRACKS
DOCKER FOR ENTERPRISE

Integrates Docker and Linux container
elements in Red Hat Enterprise Linux 7



DOCKER ACQUIRES
ORCHARD LABS

Developers of Fig, a composition and
orchestration tool for multi-container
Docker apps



DOCKER SELLS
DOTCLOUD PLATFORM

Sells dotCloud PaaS to CloudControl to
focus on the Docker project



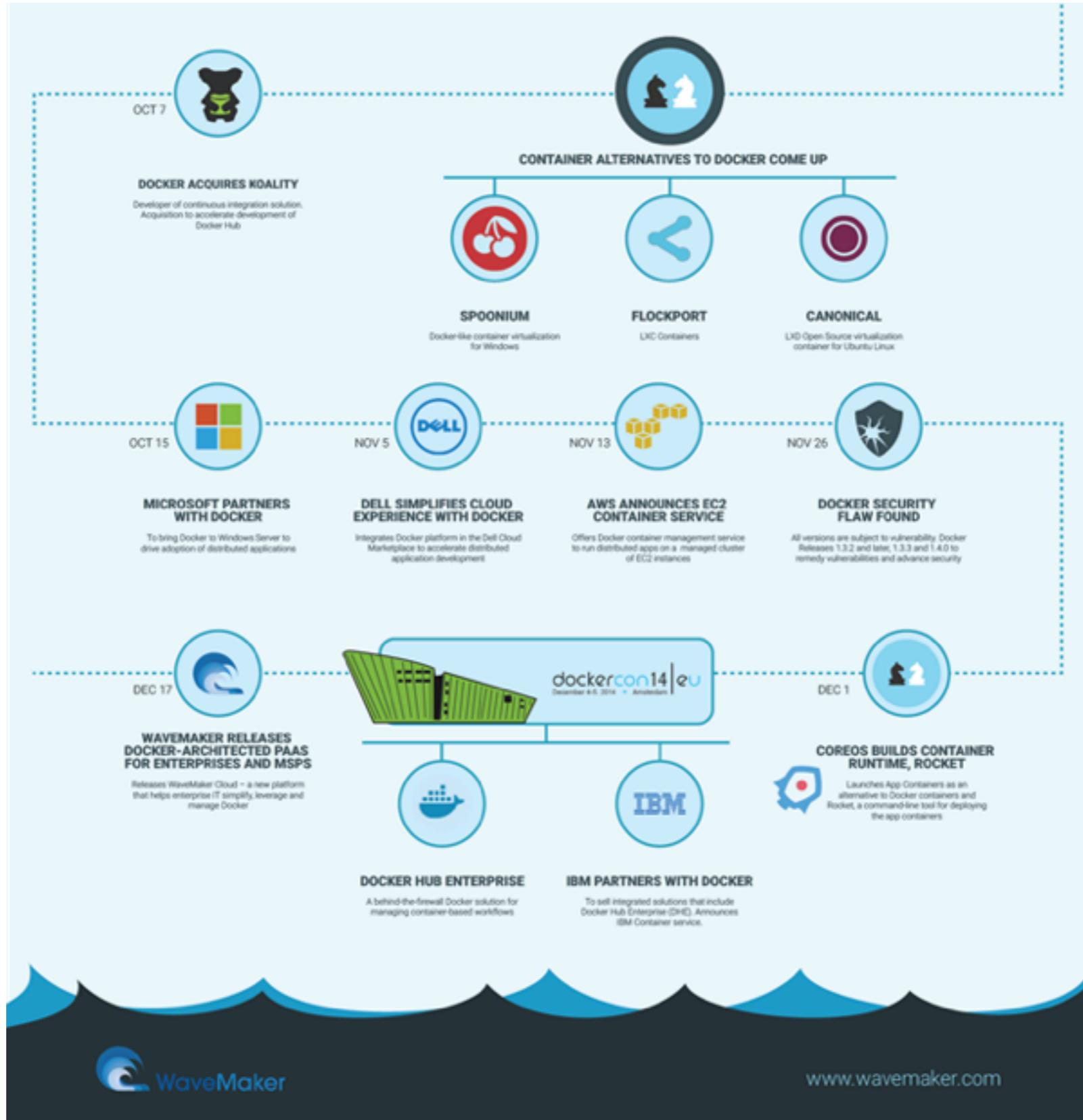
VMMATE TEAMS
WITH DOCKER

Partners with Docker to help enterprises run
and manage container-based apps



SEP 16
DOCKER RAISES
\$40 MILLION FUNDING

Series C round of funding led by
Sequoia, with a 3x increase in round size





docker



Docker Project: 2014 Year in Review

102.5 Million

Docker Container Downloads

DEC

↑18.8K%
GROWTH

66.3 Million

NOV

32 Million

46.8 Million

OCT

8.5 Million

MAY

18.8 Million

JUN

2.7 Million

MAY

4.3 Million

JAN

of Docker Container
Downloads

542,552

JAN

1.2 Million

FEB

1.5 Million

MAR

1.7 Million

APR

4.3 Million

MAY

JUN

18.8 Million

JUL

32 Million

SEP

46.8 Million

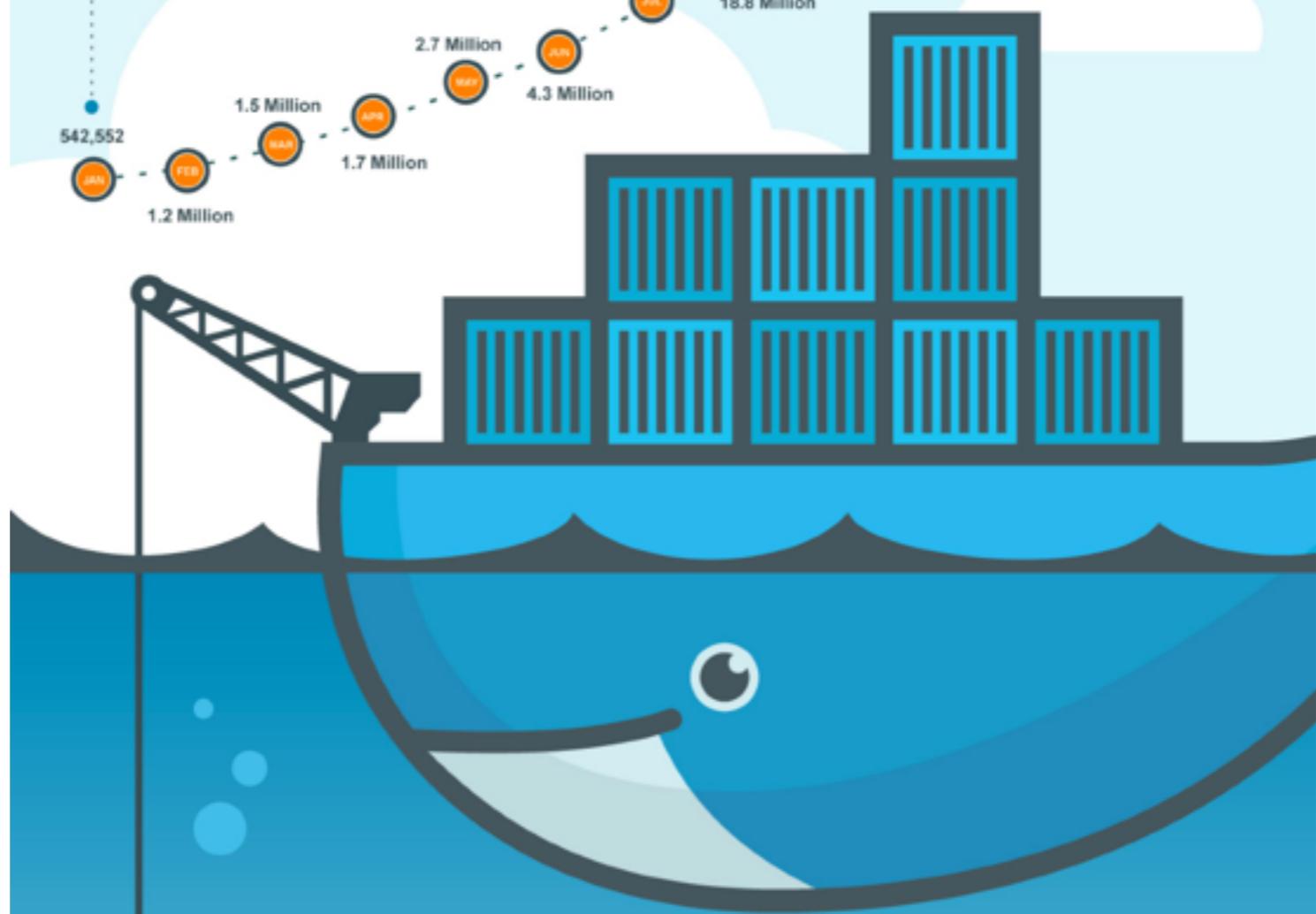
OCT

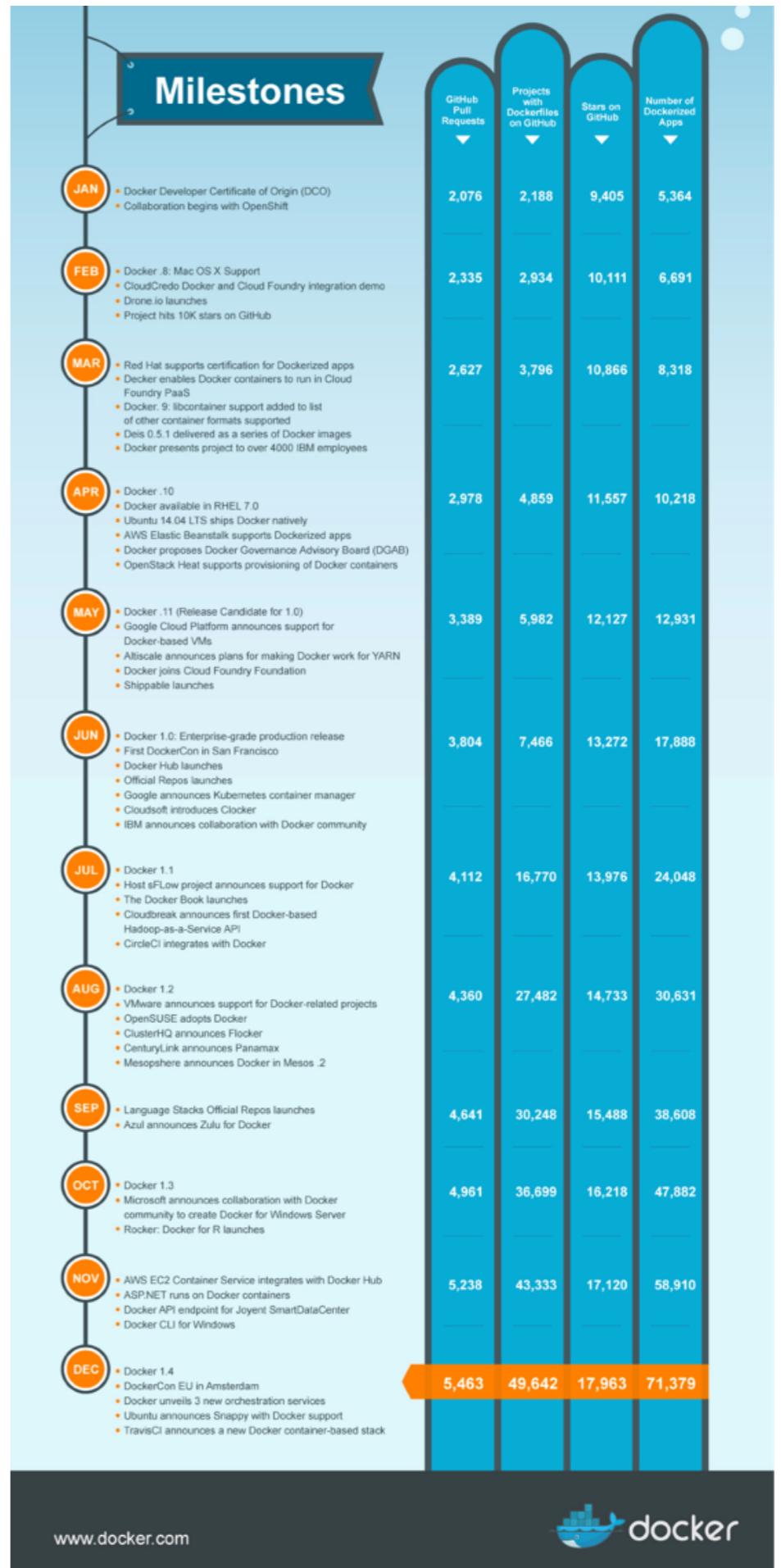
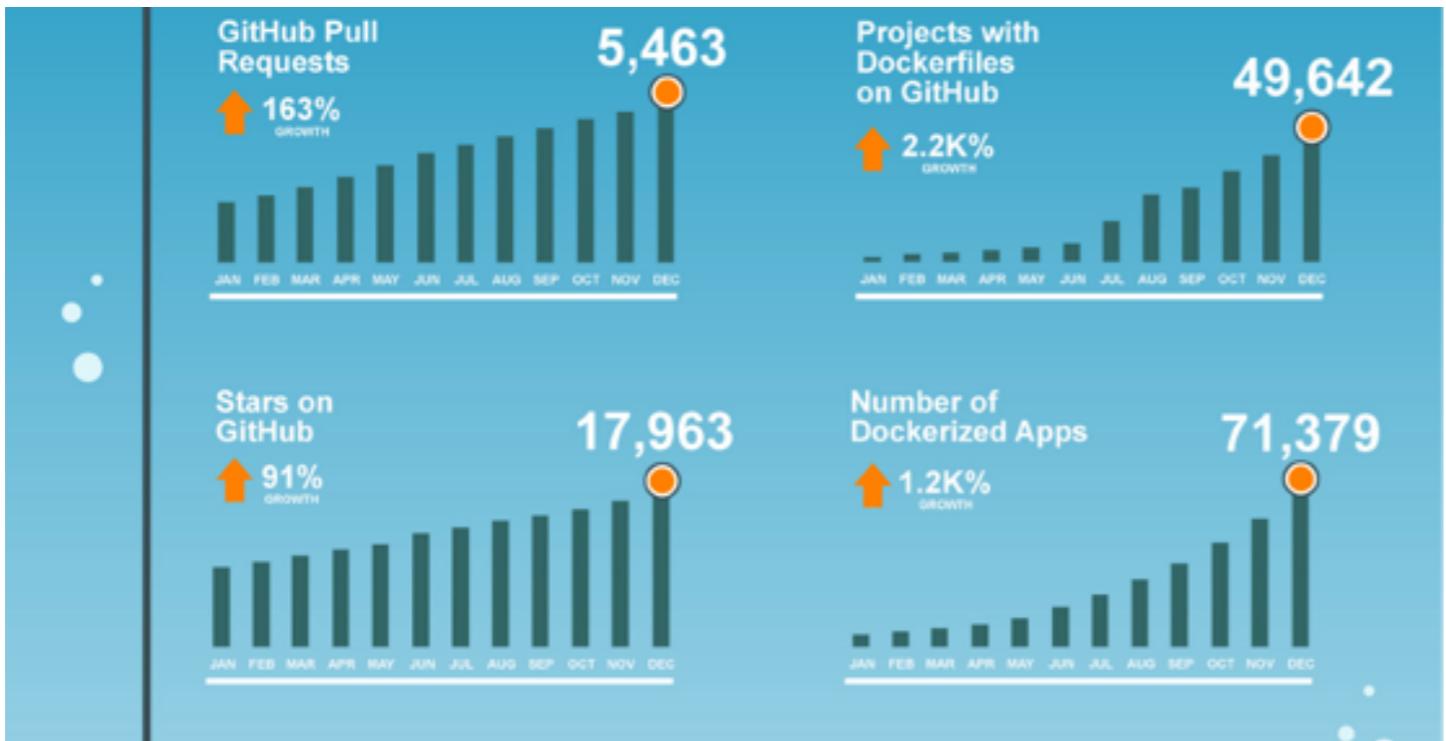
66.3 Million

NOV

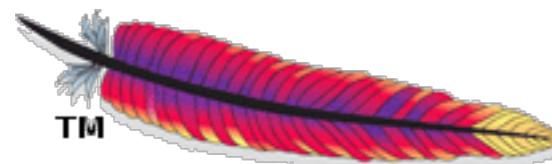
102.5 Million

DEC





Application Operating Environment



Issues

- pull = fetch + unpack, run = pull + run
- Separate download and install steps
- Download from a trusted channel + load
- docker pull <registry>
- Add 127.0.0.1 index.docker.io in /etc/hosts

Kubernetes



Kubernetes



- Open source orchestration system for Docker containers

Kubernetes



- Open source orchestration system for Docker containers
- Provide declarative primitives for the “desired state”

Kubernetes



- Open source orchestration system for Docker containers
- Provide declarative primitives for the “desired state”
 - Self-healing

Kubernetes



- Open source orchestration system for Docker containers
- Provide declarative primitives for the “desired state”
 - Self-healing
 - Auto-restarting

Kubernetes



- Open source orchestration system for Docker containers
- Provide declarative primitives for the “desired state”
 - Self-healing
 - Auto-restarting
 - Re-scheduling

Kubernetes



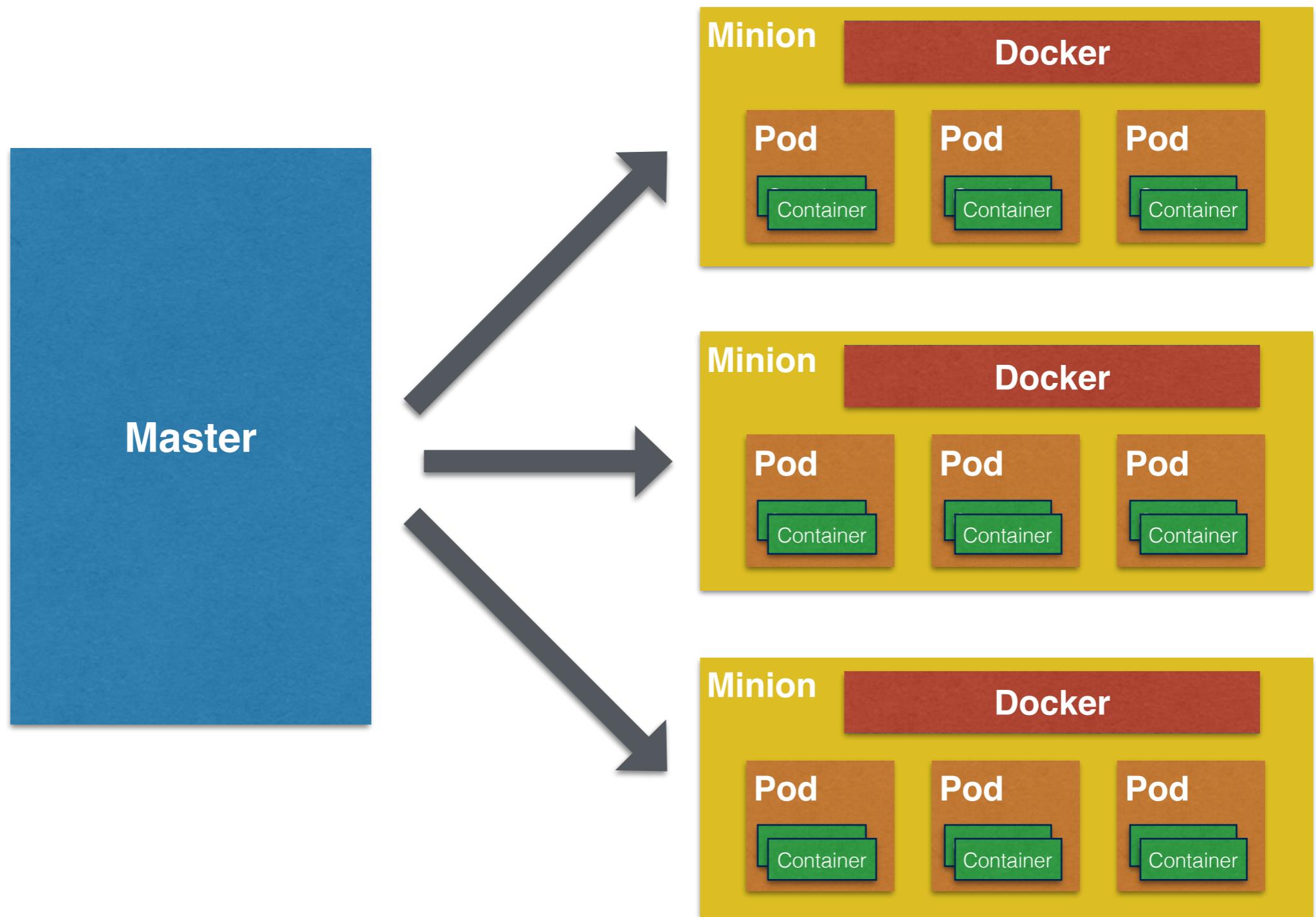
- Open source orchestration system for Docker containers
- Provide declarative primitives for the “desired state”
 - Self-healing
 - Auto-restarting
 - Re-scheduling
 - Replicating

Key Concepts



- **Pods:** Smallest deployable unit that can be created, scheduled, managed (logical collection of containers)
- **Master:** Central point that provides unified view of cluster, control one or more minions
- **Minion:** Run tasks from master

Kubernetes



Microservices

*building applications as **suites of services**. As well as the fact that services are **independently deployable and scalable**, each service also provides a **firm module boundary**, even allowing for different services to be written in **different programming languages**. They can also be **managed by different teams***

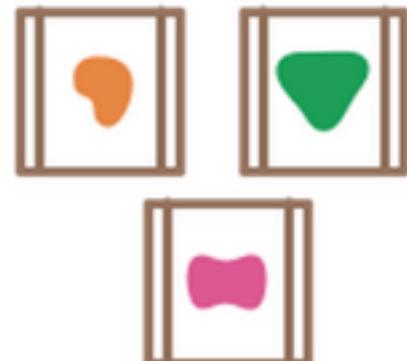
A monolithic application puts all its functionality into a single process...



... and scales by replicating the monolith on multiple servers



A microservices architecture puts each element of functionality into a separate service...



... and scales by distributing these services across servers, replicating as needed.

