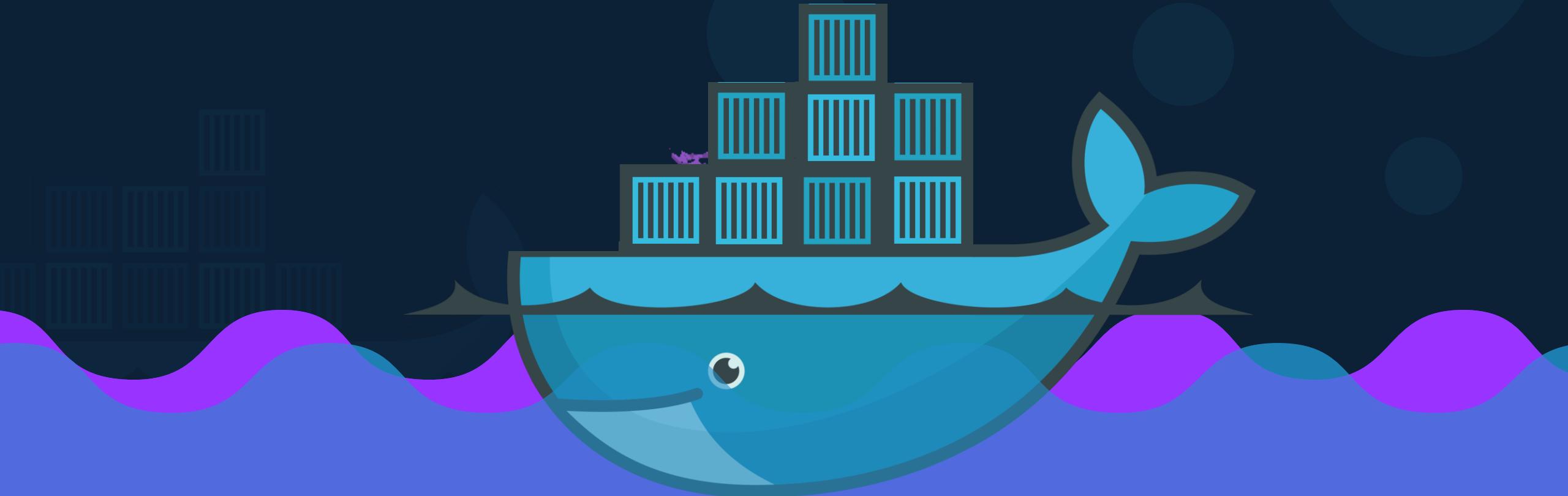


# docker

for beginners



# Objectives

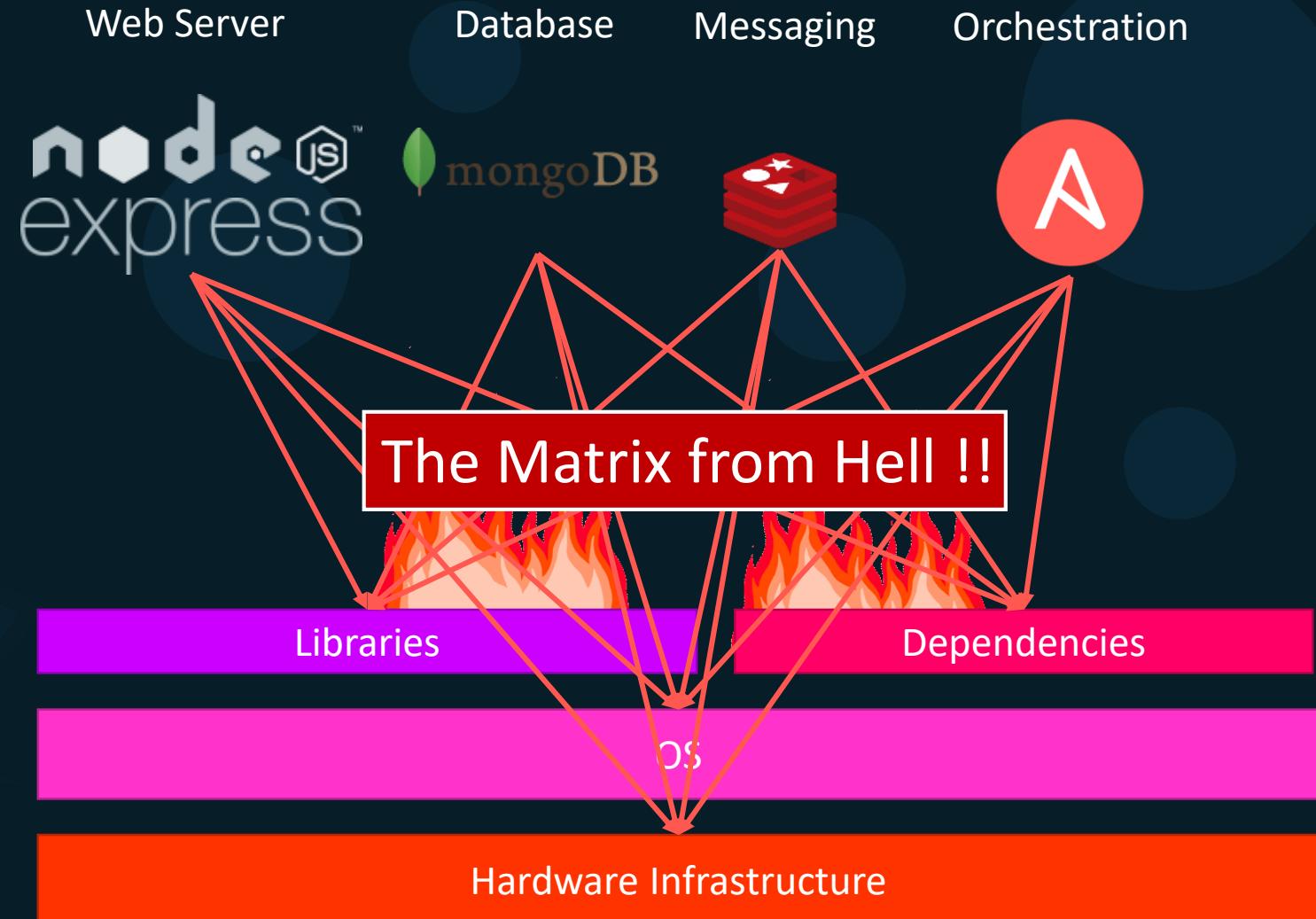
- What are Containers?
- What is Docker?
- Why do you need it?
- What can it do?
  
- Run Docker Containers
- Create a Docker Image
- Networks in Docker
- Docker Compose
  
- Docker Concepts in Depth
  
- Docker for Windows/Mac
  
- Docker Swarm
- Docker vs Kubernetes

# docker

overview

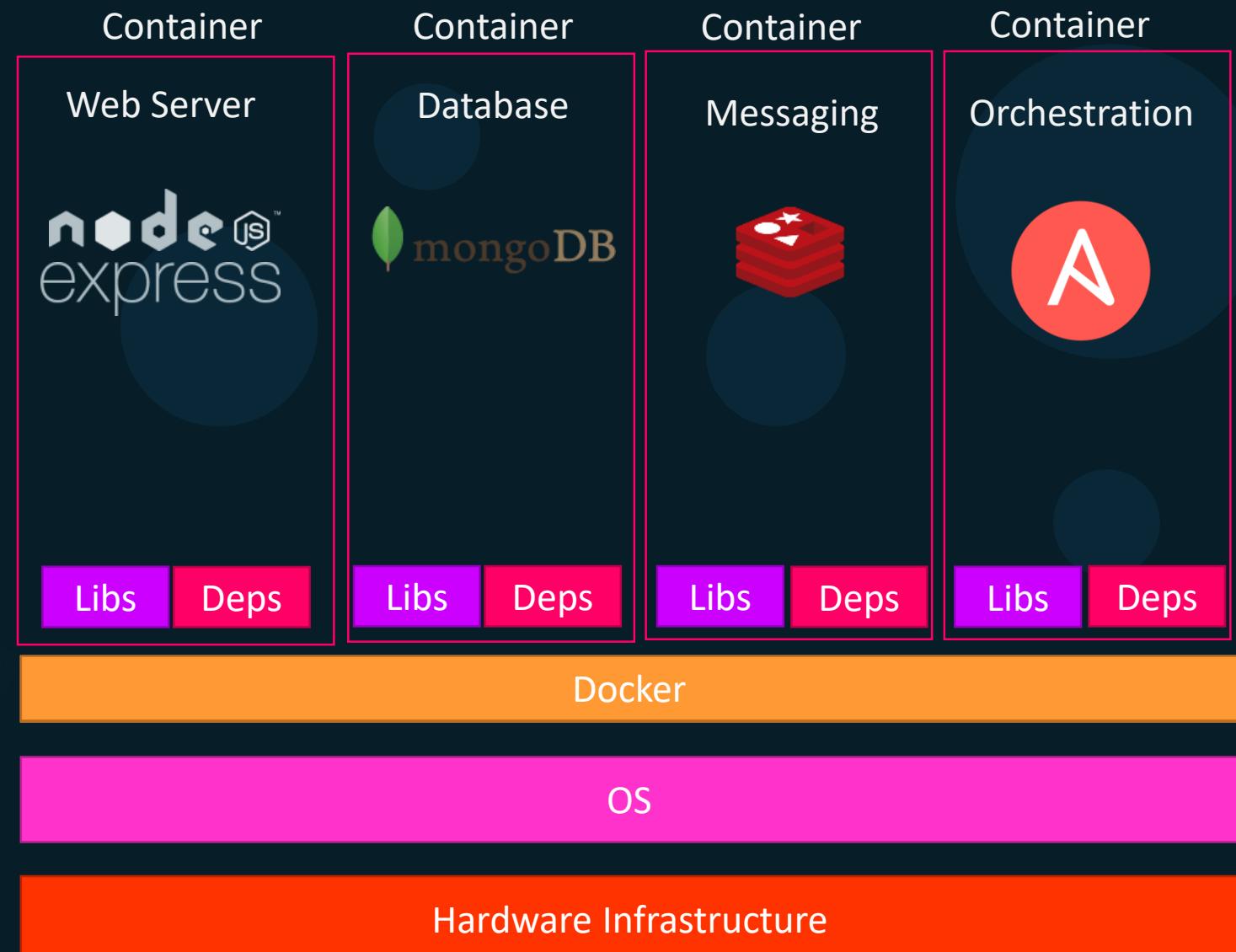
# Why do you need docker?

- Compatibility/Dependency
- Long setup time
- Different Dev/Test/Prod environments



# What can it do?

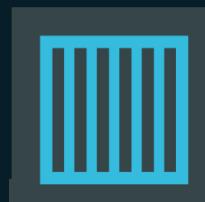
- Containerize Applications
- Run each service with its own dependencies in separate containers



# What are containers?



Processes  
Network  
Mounts



Processes  
Network  
Mounts



Processes  
Network  
Mounts



Processes  
Network  
Mounts



# Operating System



OS

Software

Software

Software

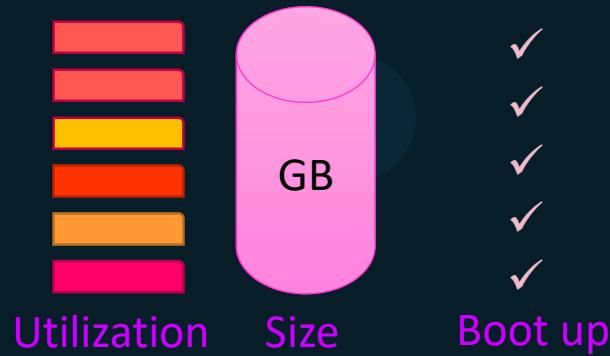
Software

OS Kernel

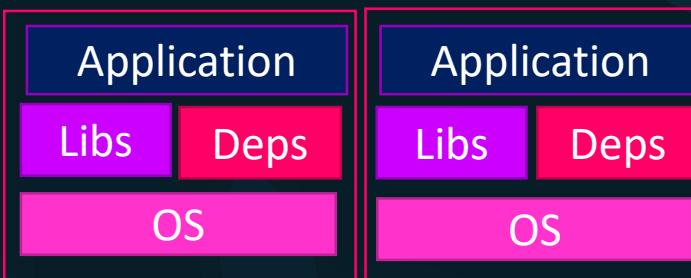
# Sharing the kernel



# Containers vs Virtual Machines

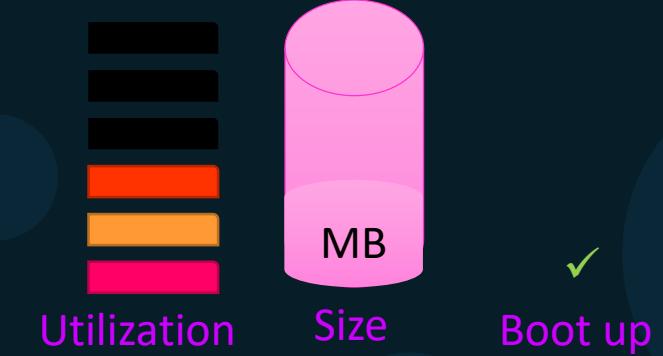


Virtual Machine      Virtual Machine

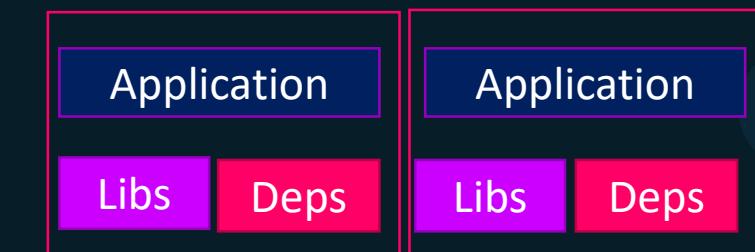


Hypervisor

Hardware Infrastructure



Container      Container

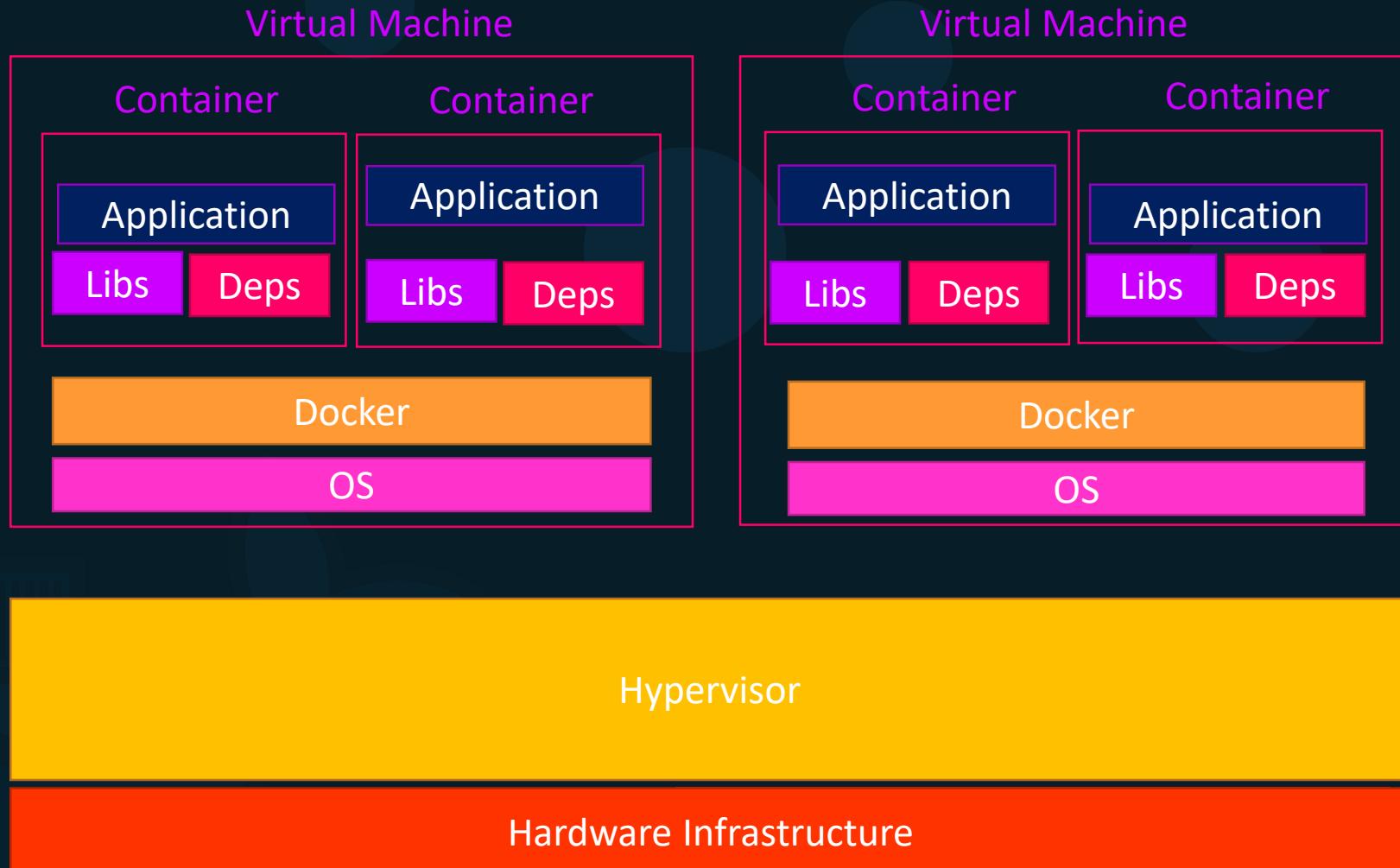


Docker

OS

Hardware Infrastructure

# Containers & Virtual Machines



# How is it done?

```
docker run ansible  
docker run mongodb  
docker run redis  
docker run nodejs  
docker run nodejs  
docker run nodejs
```

Public Docker registry - dockerhub

# Container vs image



Docker Image

Package  
Template  
Plan



Docker Container #1



Docker Container #2



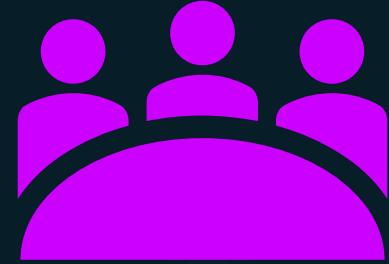
Docker Container #3



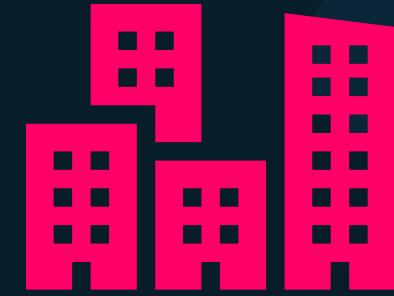
# Getting Started

d o c k e r

# Docker Editions



Community Edition



Enterprise Edition

# Community Edition



Linux



MAC



Windows



Cloud

# docker c o m m a n d s

# Run – start a container

```
▶ docker run nginx
```

```
Unable to find image 'nginx:latest' locally
latest: Pulling from library/nginx
fc7181108d40: Already exists
d2e987ca2267: Pull complete
0b760b431b11: Pull complete
Digest:
sha256:96fb261b66270b900ea5a2c17a26abbfabe95506e73c3a3c65869a6dbe83223a
Status: Downloaded newer image for nginx:latest
```

# ps – list containers

```
▶ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
796856ac413d	nginx	"nginx -g 'daemon of..."	7 seconds ago	Up 6 seconds	80/tcp	silly_sammet

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	NAMES
796856ac413d	nginx	"nginx -g 'daemon of..."	7 seconds ago	Up 6 seconds	silly_sammet
cff8ac918a2f	redis	"docker-entrypoint.s..."	6 seconds ago	Exited (0) 3 seconds ago	relaxed_aryabhatta

# STOP – stop a container

```
▶ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
796856ac413d	nginx	"nginx -g 'daemon of..."	7 seconds ago	Up 6 seconds	80/tcp	silly_sammet

```
▶ docker stop silly_sammet
```

```
silly_sammet
```

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	NAMES
796856ac413d	nginx	"nginx -g 'daemon of..."	7 seconds ago	Exited (0) 3 seconds ago	silly_sammet
cff8ac918a2f	redis	"docker-entrypoint.s..."	6 seconds ago	Exited (0) 3 seconds ago	relaxed_aryabhata

# Rm – Remove a container

```
▶ docker rm silly_sammet
```

```
silly_sammet
```

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	NAMES
cff8ac918a2f	redis	"docker-entrypoint.s..."	6 seconds ago	Exited (0) 3 seconds ago	relaxed_aryabhata

# images – List images

```
▶ docker images
```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
nginx	latest	f68d6e55e065	4 days ago	109MB
redis	latest	4760dc956b2d	15 months ago	107MB
ubuntu	latest	f975c5035748	16 months ago	112MB
alpine	latest	3fd9065eaf02	18 months ago	4.14MB

# rmi – Remove images

```
▶ docker rmi nginx
```

```
Untagged: nginx:latest
Untagged: nginx@sha256:96fb261b66270b900ea5a2c17a26abbfabef5506e73c3a3c65869a6dbe83223a
Deleted: sha256:f68d6e55e06520f152403e6d96d0de5c9790a89b4cfcc99f4626f68146fa1dbdc
Deleted: sha256:1b0c768769e2bb66e74a205317ba531473781a78b77feef8ea6fd7be7f4044e1
Deleted: sha256:34138fb60020a180e512485fb96fd42e286fb0d86cf1fa2506b11ff6b945b03f
Deleted: sha256:cf5b3c6798f77b1f78bf4e297b27cfab5b6caa982f04caeb5de7d13c255fd7a1e
```

**! Delete all dependent containers to remove image**

# Pull – download an image

```
▶ docker run nginx
```

```
Unable to find image 'nginx:latest' locally
latest: Pulling from library/nginx
fc7181108d40: Already exists
d2e987ca2267: Pull complete
0b760b431b11: Pull complete
Digest:
sha256:96fb261b66270b900ea5a2c17a26abbfabe95506e73c3a3c65869a6dbe83223a
Status: Downloaded newer image for nginx:latest
```

```
▶ docker pull nginx
```

```
Using default tag: latest
latest: Pulling from library/nginx
fc7181108d40: Pull complete
d2e987ca2267: Pull complete
0b760b431b11: Pull complete
Digest:
sha256:96fb261b66270b900ea5a2c17a26abbfabe95506e73c3a3c65869a6dbe83223a
Status: Downloaded newer image for nginx:latest
```

```
▶ docker run ubuntu
```

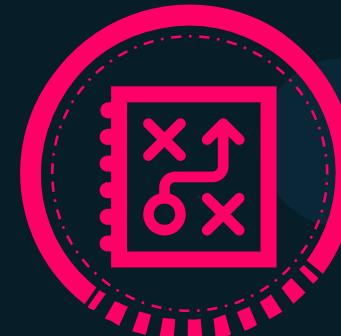
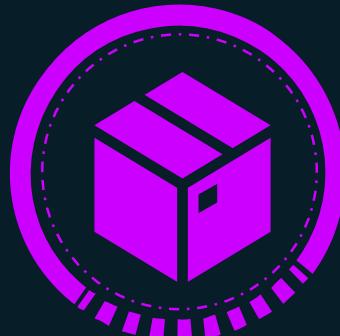
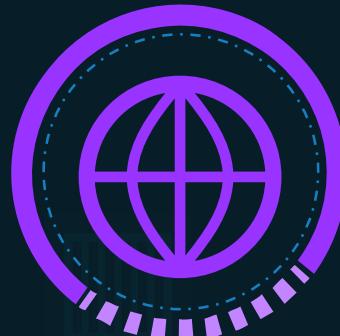
```
▶ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
--------------	-------	---------	---------	--------	-------

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
45aacca36850	ubuntu	"/bin/bash"	43 seconds ago	Exited (0) 41 seconds ago	

► docker run ubuntu



► docker ps

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
--------------	-------	---------	---------	--------	-------

► docker ps -a

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
45aacca36850	ubuntu	"/bin/bash"	43 seconds ago	Exited (0) 41 seconds ago	

# Append a command

```
▶ docker run ubuntu
```

```
▶ docker run ubuntu sleep 5
```



# Exec – execute a command

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	NAMES
538d037f94a7	ubuntu	"sleep 100"	6 seconds ago	Up 4 seconds	distracted_mcclintock

```
▶ docker exec distracted_mcclintock cat /etc/hosts
```

```
127.0.0.1      localhost
::1      localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
172.18.0.2      538d037f94a7
```

# Run – attach and detach

```
▶ docker run kodekloud/simple-webapp
```

```
This is a sample web application that displays a colored background.  
* Serving Flask app "app" (lazy loading)  
* Running on http://0.0.0.0:8080/ (Press CTRL+C to quit)
```

```
▶ docker run -d kodekloud/simple-webapp
```

```
a043d40f85fe fa414254e4775f9336ea59e19e5cf597af5c554e0a35a1631118
```

```
▶ docker attach a043d
```



do c k e r  
r u n

# Run – tag

```
docker run redis
```

```
Using default tag: latest
latest: Pulling from library/redis
f5d23c7fed46: Pull complete
Status: Downloaded newer image for redis:latest

1:C 31 Jul 2019 09:02:32.624 # o000o000o000o Redis is starting o000o000o000o
1:C 31 Jul 2019 09:02:32.624 # Redis version=5.0.5, bits=64, commit=00000000, modified=0, pid=1, just started
1:M 31 Jul 2019 09:02:32.626 # Server initialized
```

```
docker run redis:4.0
```

TAG

```
Unable to find image 'redis:4.0' locally
4.0: Pulling from library/redis
e44f086c03a2: Pull complete
Status: Downloaded newer image for redis:4.0

1:C 31 Jul 09:02:56.527 # o000o000o000o Redis is starting o000o000o000o
1:C 31 Jul 09:02:56.527 # Redis version=4.0.14, bits=64, commit=00000000, modified=0, pid=1, just started
1:M 31 Jul 09:02:56.530 # Server initialized
```

# RUN - STDIN

```
~/prompt-application$ ./app.sh  
Welcome! Please enter your name: Mumshad
```

Hello and Welcome Mumshad!

```
docker run kodekloud/simple-prompt-docker
```

Hello and Welcome !

```
docker run -i kodekloud/simple-prompt-docker
```

Mumshad

Hello and Welcome Mumshad!

```
docker run -it kodekloud/simple-prompt-docker
```

Welcome! Please enter your name: Mumshad

Hello and Welcome Mumshad!

# Run – PORT mapping

```
docker run kodekloud/webapp
```

\* Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)

http://172.17.0.2:5000

Internal IP

```
docker run -p 80:5000 kodekloud/simple-webapp
```

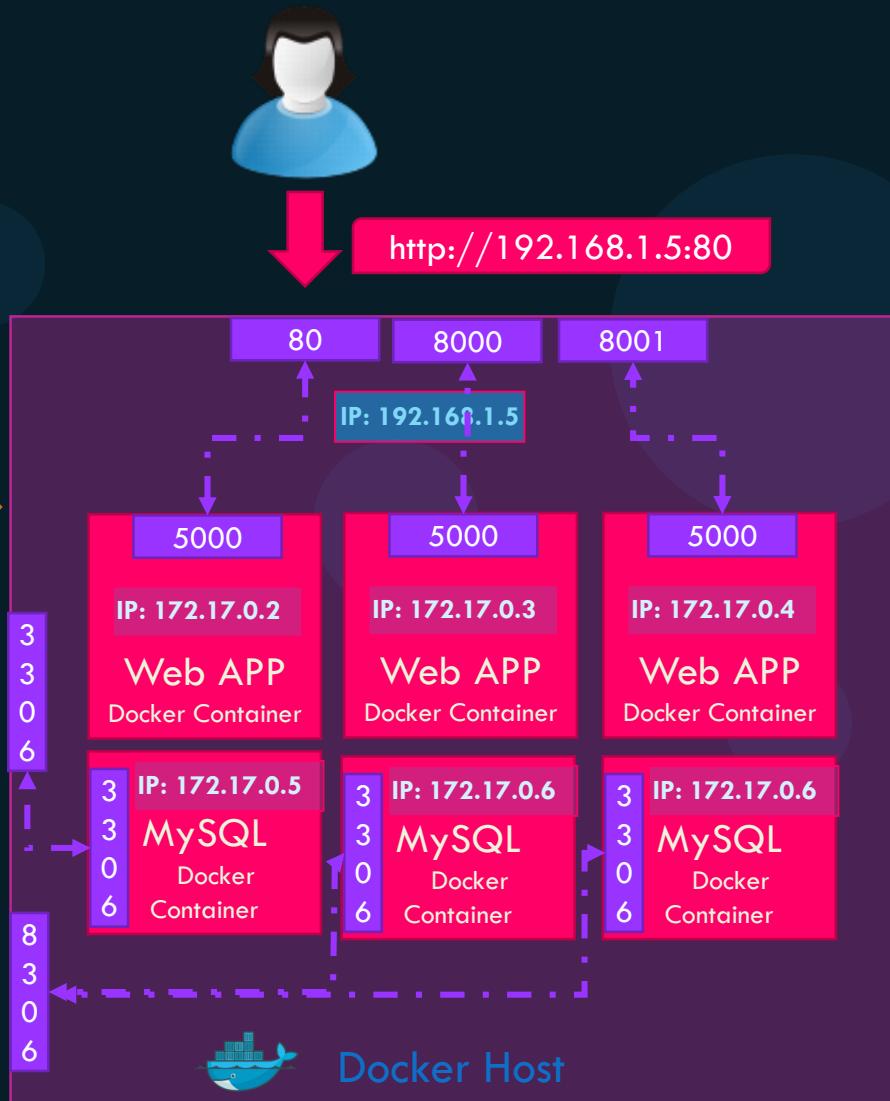
```
docker run -p 8000:5000 kodekloud/simple-webapp
```

```
docker run -p 8001:5000 kodekloud/simple-webapp
```

```
docker run -p 3306:3306 mysql
```

```
docker run -p 8306:3306 mysql
```

```
docker run -p 8306:3306 mysql
```



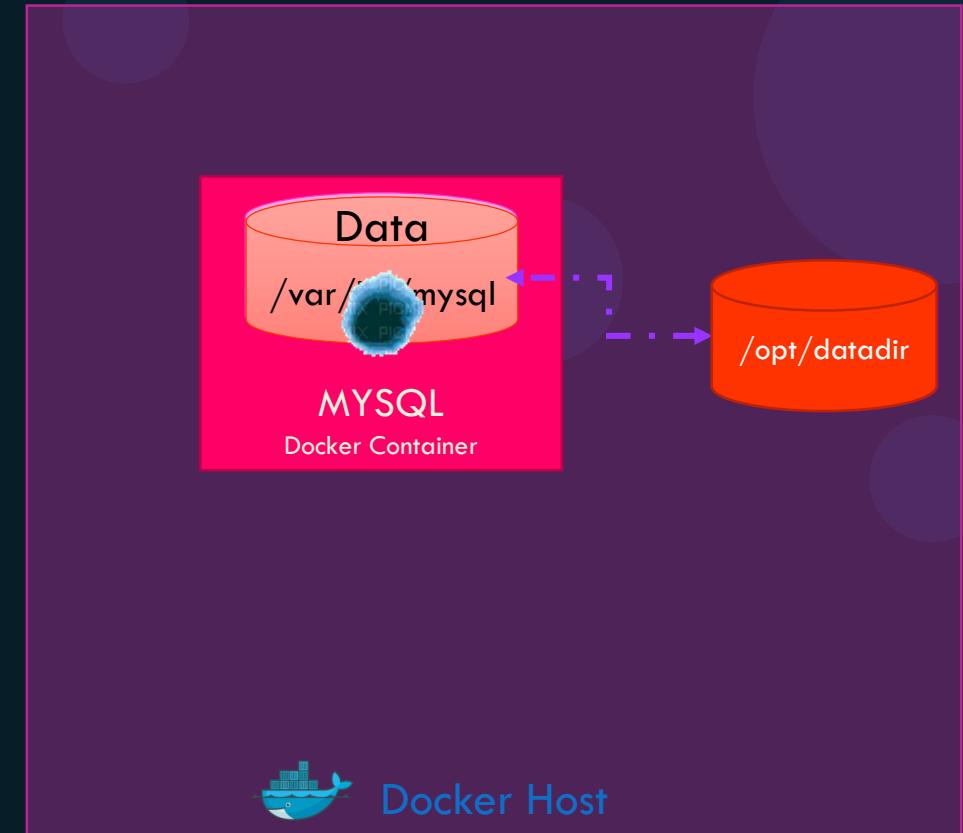
```
root@osboxes:/root # docker run -p 8306:3306 -e MYSQL_ROOT_PASSWORD=pass mysql
docker: Error response from daemon: driver failed programming external connectivity on endpoint boring_bhabha (5079d342b7e8ee11c71d46): Bind for 0.0.0.0:8306 failed: port is already allocated.
```

# RUN – Volume mapping

```
docker run mysql
```

```
docker stop mysql  
docker rm mysql
```

```
docker run -v /opt/datadir:/var/lib/mysql mysql
```



# Inspect Container

```
▶ docker inspect blissful_hopper
```

```
[  
 {  
   "Id": "35505f7810d17291261a43391d4b6c0846594d415ce4f4d0a6ffbf9cc5109048",  
   "Name": "/blissful_hopper",  
   "Path": "python",  
   "Args": [  
     "app.py"  
   ],  
   "State": {  
     "Status": "running",  
     "Running": true,  
   },  
   "Mounts": [],  
   "Config": {  
     "Entrypoint": [  
       "python",  
       "app.py"  
     ],  
   },  
   "NetworkSettings": {...}  
 }]
```

# Container Logs

```
▶ docker logs blissful_hopper
```

This is a sample web application that displays a colored background.  
A color can be specified in two ways.

1. As a command line argument with `--color` as the argument. Accepts one of red,green,blue,blue2,pink,darkblue
  2. As an Environment variable `APP_COLOR`. Accepts one of red,green,blue,blue2,pink,darkblue
  3. If none of the above then a random color is picked from the above list.
- Note: Command line argument precedes over environment variable.

```
No command line argument or environment variable. Picking a Random Color =blue
* Serving Flask app "app" (lazy loading)
* Environment: production
WARNING: Do not use the development server in a production environment.
Use a production WSGI server instead.
* Debug mode: off
* Running on http://0.0.0.0:8080/ (Press CTRL+C to quit)
```

# docker environment variables

# Environment Variables

app.py

```
import os
from flask import Flask

app = Flask(__name__)

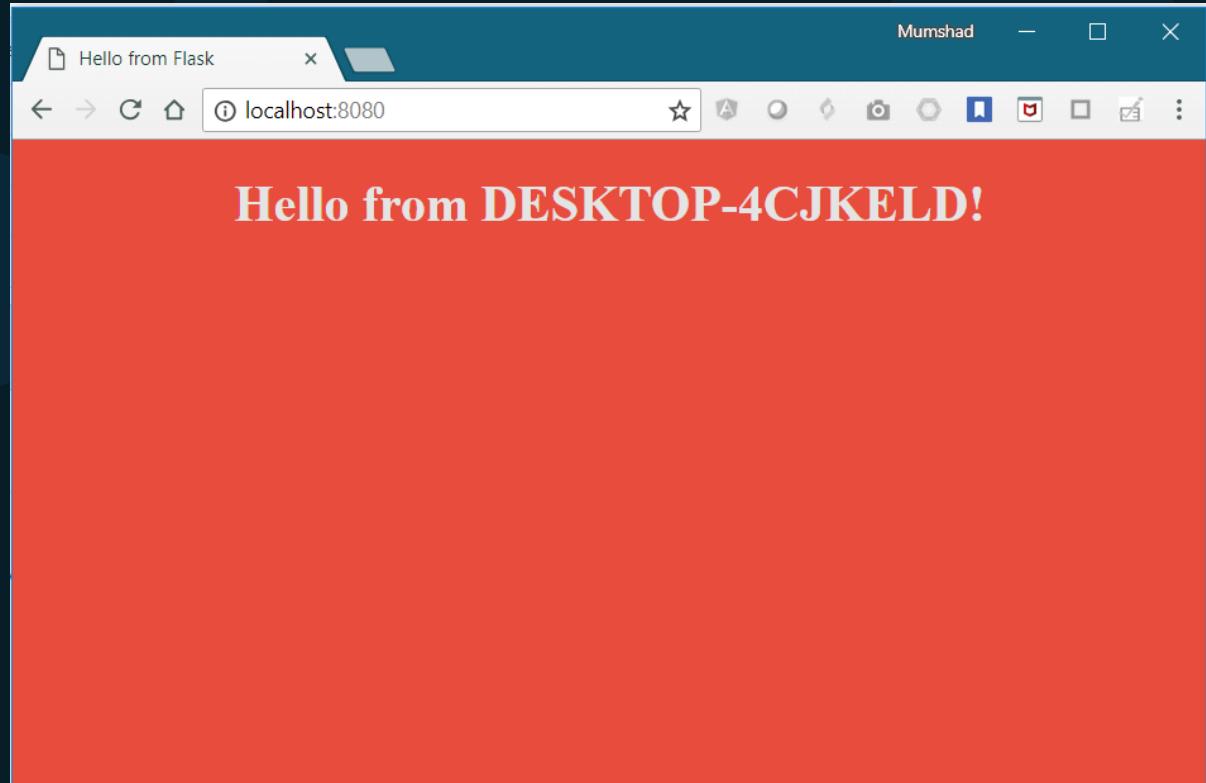
...
...

color = "red"

@app.route("/")
def main():
    print(color)
    return render_template('hello.html', color=color)

if __name__ == "__main__":
    app.run(host="0.0.0.0", port="8080")
```

▶ python app.py



# Environment Variables

app.py

```
import os
from flask import Flask

app = Flask(__name__)

...
...

color = "red"

@app.route("/")
def main():
    print(color)
    return render_template('hello.html', color=color)

if __name__ == "__main__":
    app.run(host="0.0.0.0", port="8080")
```

# Environment Variables

app.py

```
import os
from flask import Flask

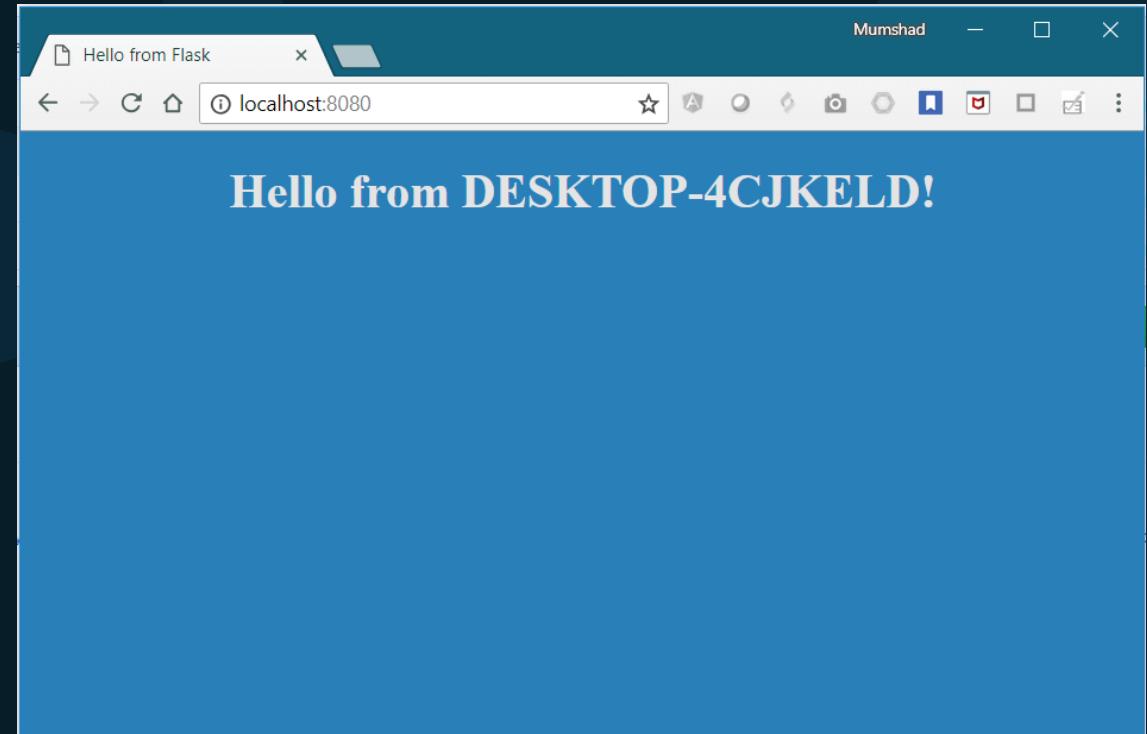
app = Flask(__name__)

...
...

color = os.environ.get('APP_COLOR')

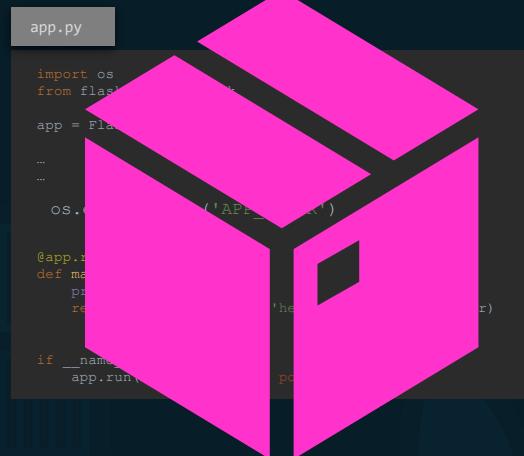
@app.route("/")
def main():
    print(color)
    return render_template('hello.html', color=color)

if __name__ == "__main__":
    app.run(host="0.0.0.0", port="8080")
```

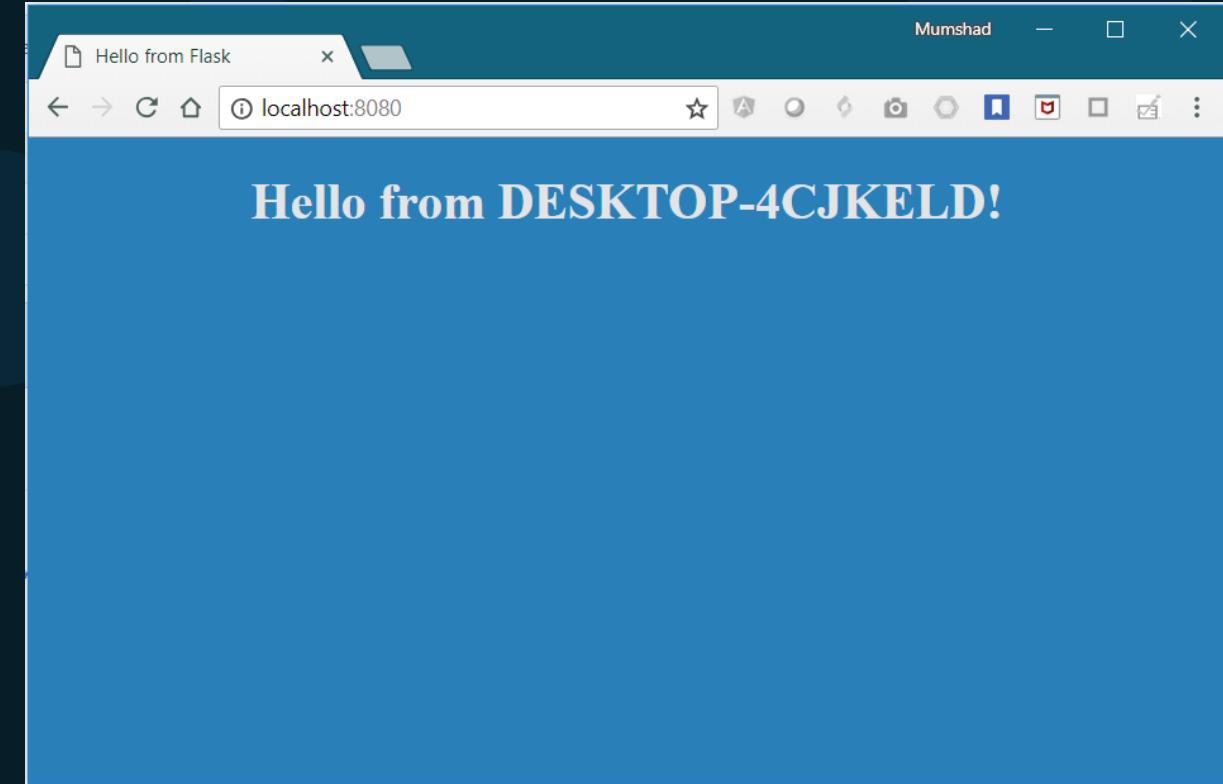


▶ export APP\_COLOR=blue; python app.py

# ENV Variables in Docker



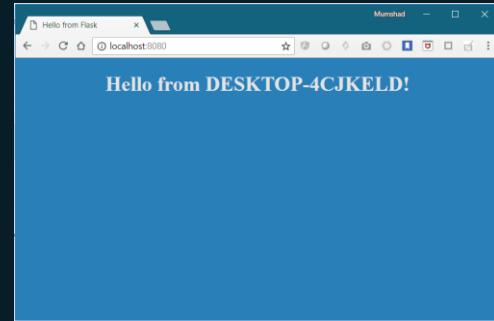
```
app.py
import os
from flask import Flask
app = Flask(__name__)
...
os.environ['APP_COLOR'] = 'blue'
@app.route('/')
def main():
    print('Hello from DESKTOP-4CJKELD!')
    return 'Hello from DESKTOP-4CJKELD!'
if __name__ == '__main__':
    app.run()
```



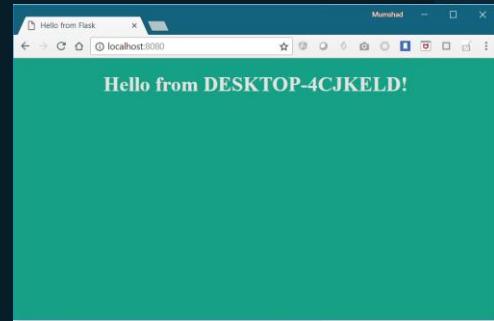
► docker run -e APP\_COLOR=blue

# ENV Variables in Docker

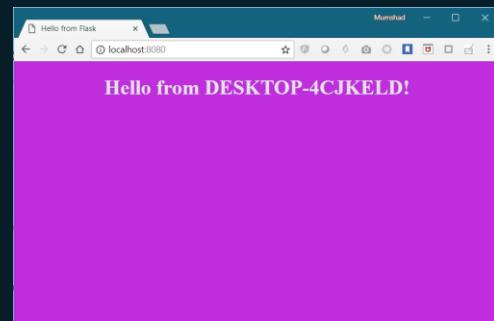
```
▶ docker run -e APP_COLOR=blue simple-webapp-color
```



```
▶ docker run -e APP_COLOR=green simple-webapp-color
```



```
▶ docker run -e APP_COLOR=pink simple-webapp-color
```



# Inspect Environment Variable

```
▶ docker inspect blissful_hopper
```

```
[  
  {  
    "Id": "35505f7810d17291261a43391d4b6c0846594d415ce4f4d0a6ffbf9cc5109048",  
    "State": {  
      "Status": "running",  
      "Running": true,  
    },  
  
    "Mounts": [],  
    "Config": {  
      "Env": [  
        "APP_COLOR=blue",  
        "LANG=C.UTF-8",  
        "GPG_KEY=0D96DF4D4110E5C43FBFB17F2D347EA6AA65421D",  
        "PYTHON_VERSION=3.6.6",  
        "PYTHON_PIP_VERSION=18.1"  
      ],  
      "Entrypoint": [  
        "python",  
        "app.py"  
      ],  
    }  
  }  
]
```



# d o c k e r i m a g e s

# What am I containerizing?



# How to create my own image?

## Dockerfile

```
FROM Ubuntu

RUN apt-get update
RUN apt-get install python

RUN pip install flask
RUN pip install flask-mysql

COPY . /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

1. OS - Ubuntu

2. Update apt repo

3. Install dependencies using apt

4. Install Python dependencies using pip

5. Copy source code to /opt folder

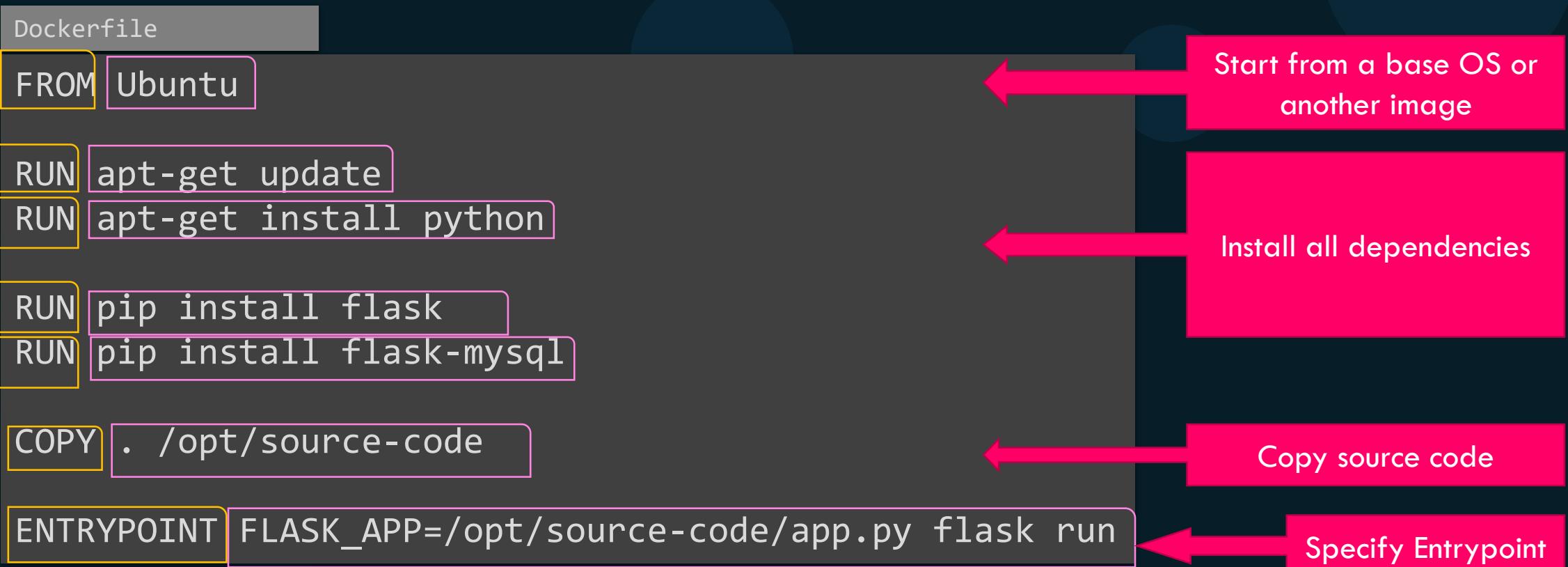
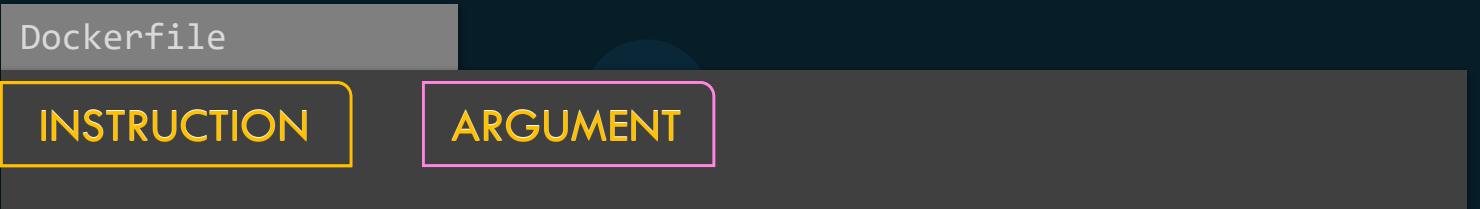
6. Run the web server using “flask” command

```
docker build Dockerfile -t mmumshad/my-custom-app
```

```
docker push mmumshad/my-custom-app
```

Docker  
Registry

# Dockerfile

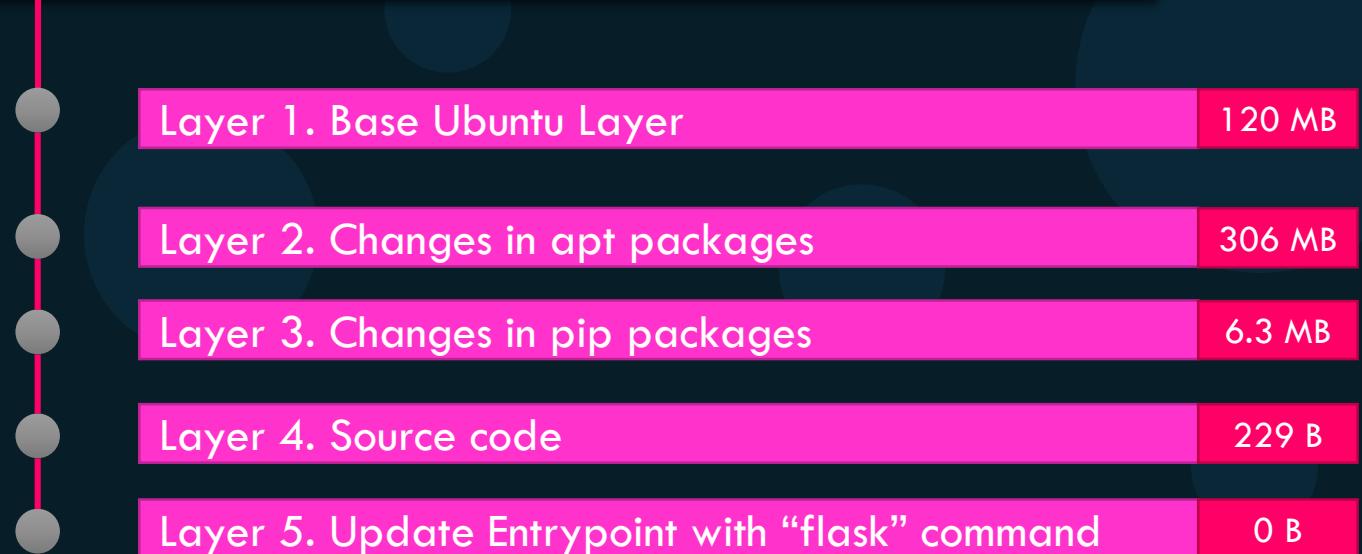


# Layered architecture

Dockerfile

```
FROM Ubuntu  
  
RUN apt-get update && apt-get -y install python  
  
RUN pip install flask flask-mysql  
  
COPY . /opt/source-code  
  
ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

```
docker build Dockerfile -t mmumshad/my-custom-app
```



```
root@osboxes:/root/simple-webapp-docker # docker history mmumshad/simple-webapp
IMAGE          CREATED      CREATED BY
1a45ba829f10  About an hour ago  /bin/sh -c #(nop) ENTRYPOINT ["/bin/sh" ... 0B
37d37ed8fe99  About an hour ago  /bin/sh -c #(nop) COPY file:29b92853d73898... 229B
d6aaebf8ded0  About an hour ago  /bin/sh -c pip install flask flask-mysql 6.39MB
e4c055538e60  About an hour ago  /bin/sh -c apt-get update && apt-get insta... 306MB
ccc7a11d65b1  2 weeks ago     /bin/sh -c #(nop) CMD ["/bin/bash"] 0B
<missing>      2 weeks ago     /bin/sh -c mkdir -p /run/systemd && echo '... 7B
<missing>      2 weeks ago     /bin/sh -c sed -i 's/^#\s*/(deb.*universe\... 2.76kB
<missing>      2 weeks ago     /bin/sh -c rm -rf /var/lib/apt/lists/* 0B
<missing>      2 weeks ago     /bin/sh -c set -xe  && echo '#!/bin/sh' >... 745B
<missing>      2 weeks ago     /bin/sh -c #(nop) ADD file:39d3593ea220e68... 120MB
```

# Docker build output

```
root@osboxes:/root/simple-webapp-docker # docker build .
Sending build context to Docker daemon 3.072kB
Step 1/5 : FROM ubuntu
--> ccc7a11d65b1
Step 2/5 : RUN apt-get update && apt-get install -y python python-setuptools python-dev
--> Running in a7840dbfad17
Get:1 http://archive.ubuntu.com/ubuntu xenial InRelease [247 kB]
Get:2 http://security.ubuntu.com/ubuntu xenial-security InRelease [102 kB]
Get:3 http://archive.ubuntu.com/ubuntu xenial-updates InRelease [102 kB]
Get:4 http://security.ubuntu.com/ubuntu xenial-security/universe Sources [46.3 kB]
Get:5 http://archive.ubuntu.com/ubuntu xenial-backports InRelease [102 kB]
Get:6 http://security.ubuntu.com/ubuntu xenial-security/main amd64 Packages [440 kB]
Step 3/5 : RUN pip install flask flask-mysql
--> Running in a4a6c9190ba3
Collecting flask
  Downloading Flask-0.12.2-py2.py3-none-any.whl (83kB)
Collecting flask-mysql
  Downloading Flask_SQLAlchemy-1.4.0-py2.py3-none-any.whl
Removing intermediate container a4a6c9190ba3
Step 4/5 : COPY app.py /opt/
--> e7cdab17e782
Removing intermediate container faaaaaf63c512
Step 5/5 : ENTRYPOINT FLASK_APP=/opt/app.py flask run --host=0.0.0.0
--> Running in d452c574a8bb
--> 9f27c36920bc
Removing intermediate container d452c574a8bb
Successfully built 9f27c36920bc
```

# failure

Layer 1. Base Ubuntu Layer

Layer 2. Changes in apt packages

Layer 3. Changes in pip packages

Layer 4. Source code

Layer 5. Update Entrypoint with “flask” command

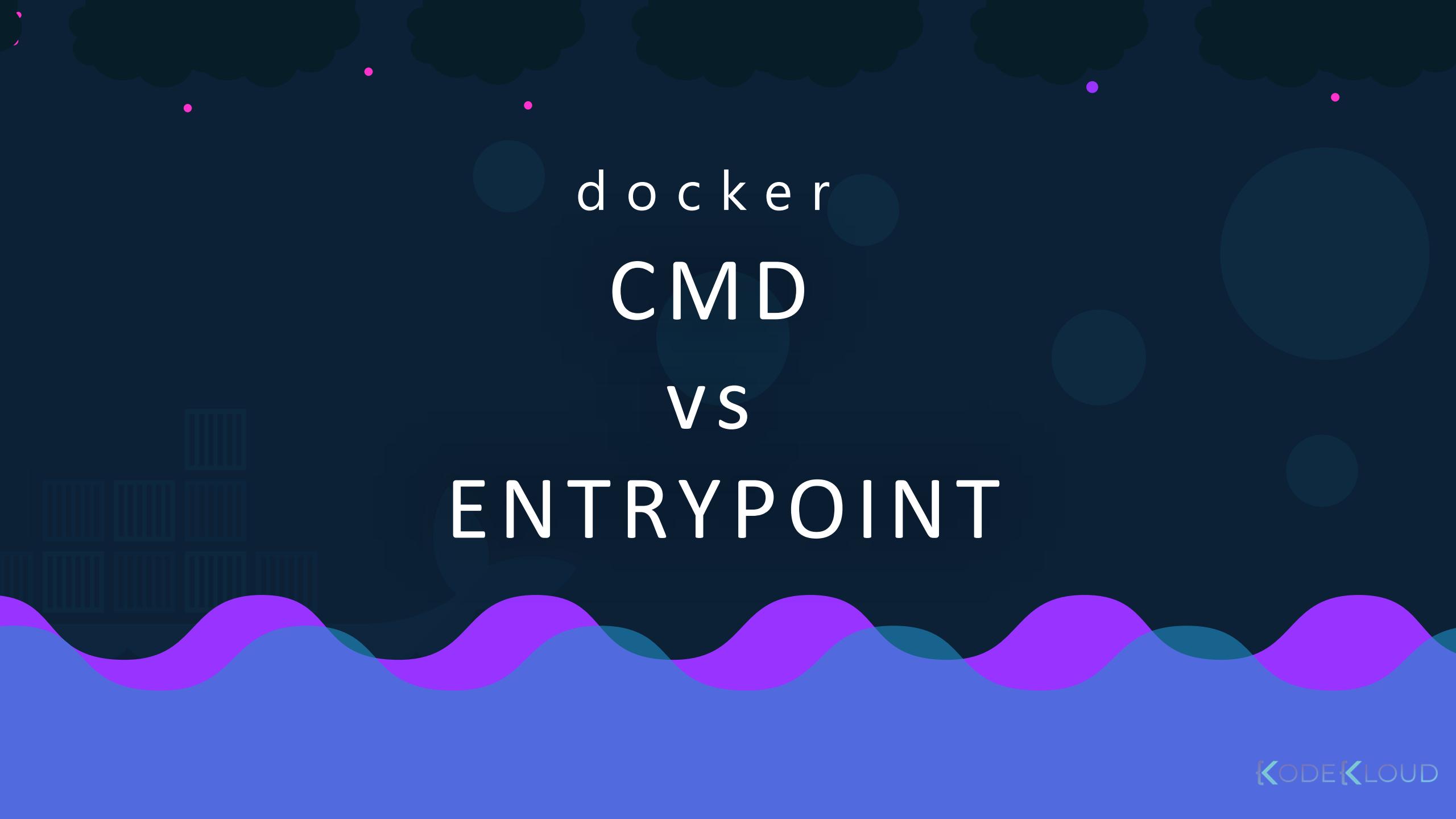
```
docker build Dockerfile -t mmumshad/my-custom-app
```

```
root@osboxes:/root/simple-webapp-docker # docker build .
Sending build context to Docker daemon 5.12kB
Step 1/5 : FROM ubuntu
--> ccc7a11d65b1
Step 2/5 : RUN apt-get update && apt-get install -y python python-pip
--> Using cache
--> e4c055538e60
Step 3/5 : RUN pip install flask
--> Running in aacdaccd7403
Collecting flask
  Downloading Flask-0.12.2-py2.py3-none-any.whl (83kB)
Removing intermediate container aacdaccd7403
Step 4/5 : COPY app.py /opt/
--> af41ef57f6f3
Removing intermediate container a49cc8befc8f
Step 5/5 : ENTRYPOINT FLASK_APP=/opt/app.py flask run --host=0.0.0.0
--> Running in 3d745ff07d5a
--> 910416d360b6
Removing intermediate container 3d745ff07d5a
Successfully built 910416d360b6
```

# What can you containerize?



Containerize Everything!!!



# docker CMD vs ENTRYPOINT

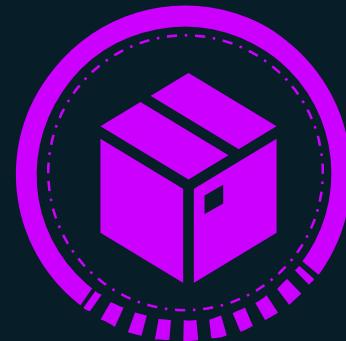
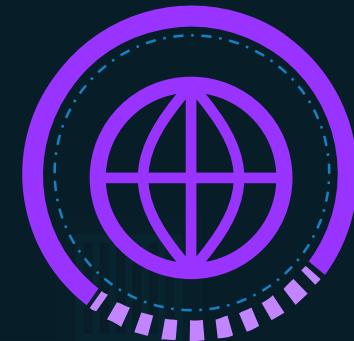
```
▶ docker run ubuntu
```

```
▶ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
--------------	-------	---------	---------	--------	-------

```
▶ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
45aacca36850	ubuntu	"/bin/bash"	43 seconds ago	Exited (0) 41 seconds ago	



```
# Install Nginx.  
RUN \  
    add-apt-repository -y ppa:nginx/stable && \  
    apt-get update && \  
    apt-get install -y nginx && \  
    rm -rf /var/lib/apt/lists/* && \  
    echo "\ndaemon off;" >> /etc/nginx/nginx.conf && \  
    chown -R www-data:www-data /var/lib/nginx  
  
# Define mountable directories.  
VOLUME ["/etc/nginx/sites-enabled", "/etc/nginx/certs", "/etc/nginx/cor  
  
# Define working directory.  
WORKDIR /etc/nginx  
  
# Define default command.  
CMD ["nginx"]  
  
ARG MYSQL_SERVER_PACKAGE_URL=https://repo.mysql.com/yum/mysql-8.0-community/docker/x86_64/  
ARG MYSQL_SHELL_PACKAGE_URL=https://repo.mysql.com/yum/mysql-tools-community/el/7/x86_64/  
  
# Install server  
RUN rpmkeys --import https://repo.mysql.com/RPM-GPG-KEY-mysql \  
    && yum install -y $MYSQL_SERVER_PACKAGE_URL $MYSQL_SHELL_PACKAGE_URL libpwquality \  
    && yum clean all \  
    && mkdir /docker-entrypoint-initdb.d  
  
VOLUME /var/lib/mysql  
  
COPY docker-entrypoint.sh /entrypoint.sh  
COPY healthcheck.sh /healthcheck.sh  
ENTRYPOINT ["/entrypoint.sh"]  
HEALTHCHECK CMD /healthcheck.sh  
EXPOSE 3306 33060  
CMD ["mysqld"]
```

```
# Pull base image.  
FROM ubuntu:14.04  
  
# Install.  
RUN \  
    sed -i 's/# \(.*multiverse$\)/\1/g' /etc/apt/sources.list && \  
    apt-get update && \  
    apt-get -y upgrade && \  
    apt-get install -y build-essential && \  
    apt-get install -y software-properties-common && \  
    apt-get install -y byobu curl git htop man unzip vim wget && \  
    rm -rf /var/lib/apt/lists/*  
  
# Add files.  
ADD root/.bashrc /root/.bashrc  
ADD root/.gitconfig /root/.gitconfig  
ADD root/.scripts /root/.scripts  
  
# Set environment variables.  
ENV HOME /root  
  
# Define working directory.  
WORKDIR /root  
  
# Define default command.  
CMD ["bash"]
```

▶ docker run ubuntu [COMMAND]

▶ docker run ubuntu sleep 5



```
FROM Ubuntu
```

```
CMD sleep 5
```

CMD command param1

CMD ["command", "param1"]

CMD sleep 5

CMD ["sleep", "5"]

CMD ["sleep 5"]



```
▶ docker build -t ubuntu-sleeper .
```

```
▶ docker run ubuntu-sleeper
```



```
FROM Ubuntu
```

```
CMD sleep 5
```

Command at Startup: sleep 10

```
▶ docker run ubuntu-sleeper sleep 10
```

```
FROM Ubuntu
```

```
ENTRYPOINT [ "sleep" ]
```

Command at Startup:

```
▶ docker run ubuntu-sleeper
```

```
sleep: missing operand
Try 'sleep --help' for more information.
```

Command at Startup:

```
FROM Ubuntu
```

```
ENTRYPOINT ["sleep"]
```

```
CMD ["5"]
```

Command at Startup:

```
▶ docker run ubuntu-sleeper 10
```

Command at Startup:

```
▶ docker run --entrypoint sleep 10 ubuntu-sleeper 10
```

Command at Startup:

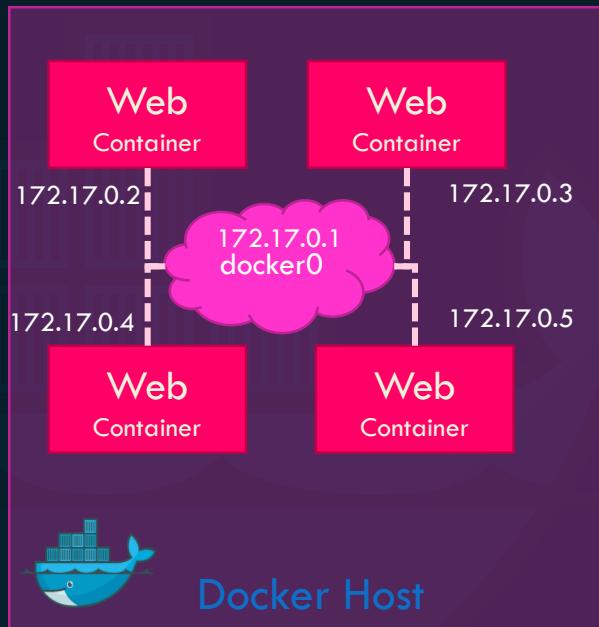


# d o c k e r networking

# Default networks



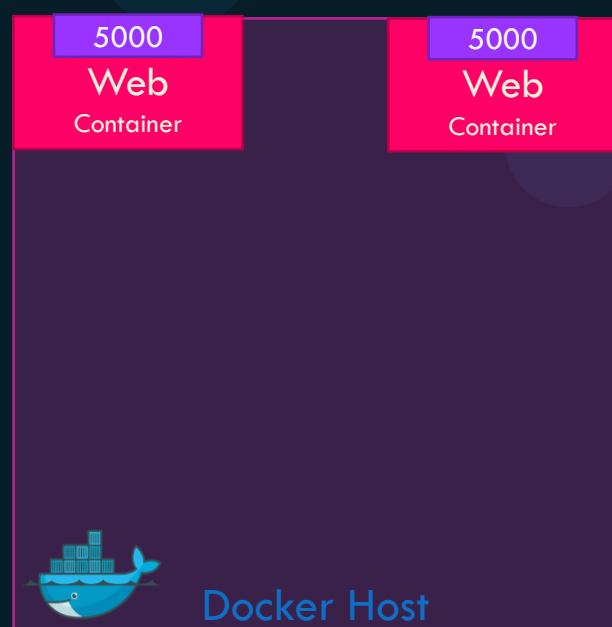
```
docker run ubuntu
```



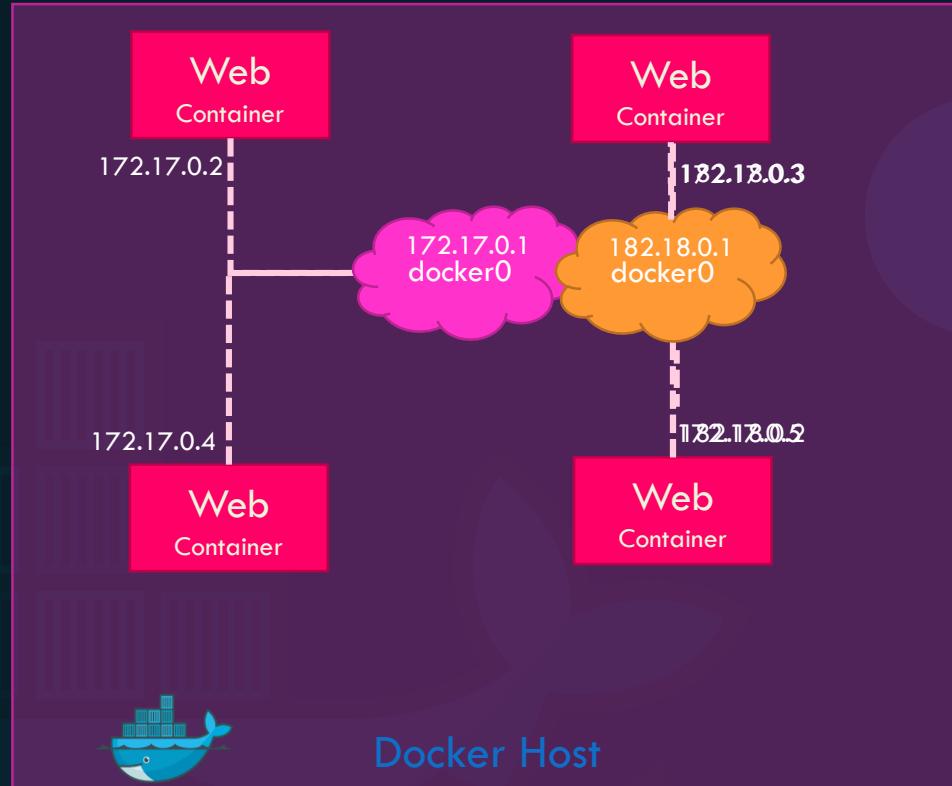
```
docker run Ubuntu --network=none
```



```
docker run Ubuntu --network=host
```



# User-defined networks



```
docker network create \
--driver bridge \
--subnet 182.18.0.0/16
custom-isolated-network
```

```
docker network ls
```

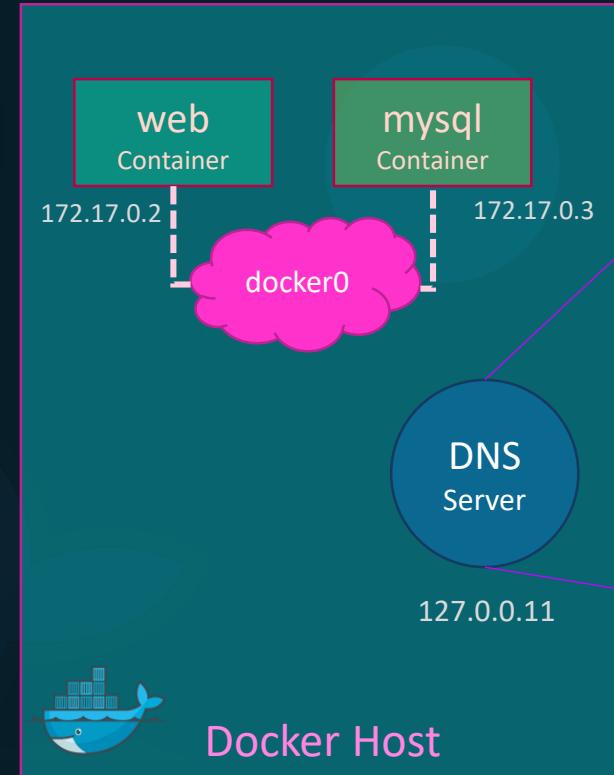
NETWORK ID	NAME	DRIVER	SCOPE
dba0fb9370fe	bridge	bridge	local
46d476b87cd9	customer-isolated-network	bridge	local
6de685cec1ce	docker_gwbridge	bridge	local
e29d188b4e47	host	host	local
mmrho7vsb9rm	ingress	overlay	swarm
d9f11695f0d6	none	null	local
d371b4009142	simplewebappdocker_default	bridge	local

# Inspect Network

```
▶ docker inspect blissful_hopper
[
  {
    "Id": "35505f7810d17291261a43391d4b6c0846594d415ce4f4d0a6ffbf9cc5109048",
    "Name": "/blissful_hopper",
    "NetworkSettings": {
      "Bridge": "",
      "Gateway": "172.17.0.1",
      "IPAddress": "172.17.0.6",
      "MacAddress": "02:42:ac:11:00:06",
      "Networks": {
        "bridge": {
          "Gateway": "172.17.0.1",
          "IPAddress": "172.17.0.6",
          "MacAddress": "02:42:ac:11:00:06"
        }
      }
    }
]
```

# Embedded DNS

```
mysql.connect( mysql )
```



Host	IP
web	172.17.0.2
mysql	172.17.0.3



# d o c k e r storage

# File system

```
📁 /var/lib/docker
  📁 aufs
  📁 containers
  📁 image
  📁 volumes
```

# Layered architecture

Dockerfile

```
FROM Ubuntu

RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY . /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

```
docker build Dockerfile -t mmumshad/my-custom-app
```

Dockerfile2

```
FROM Ubuntu

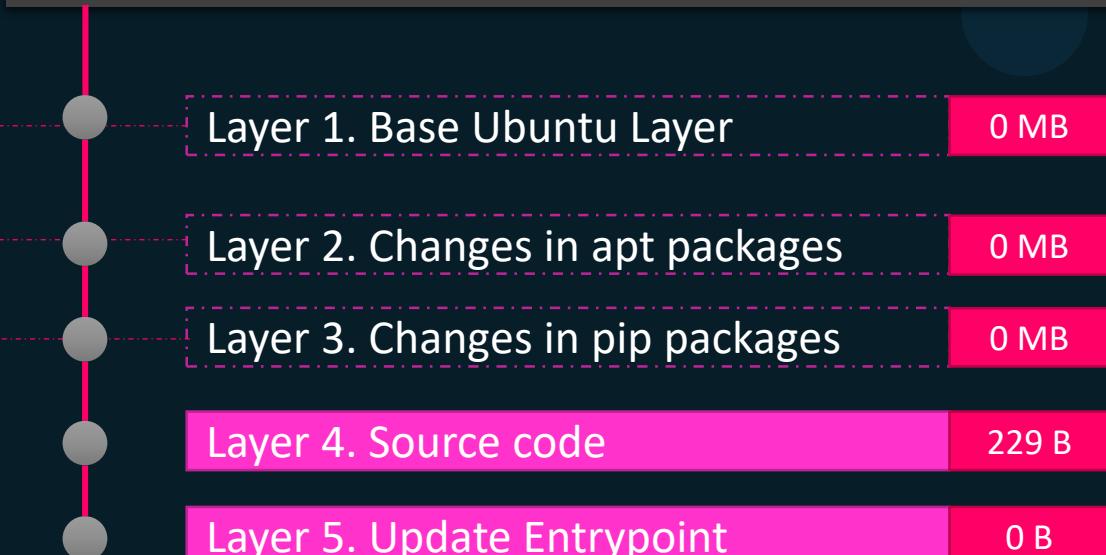
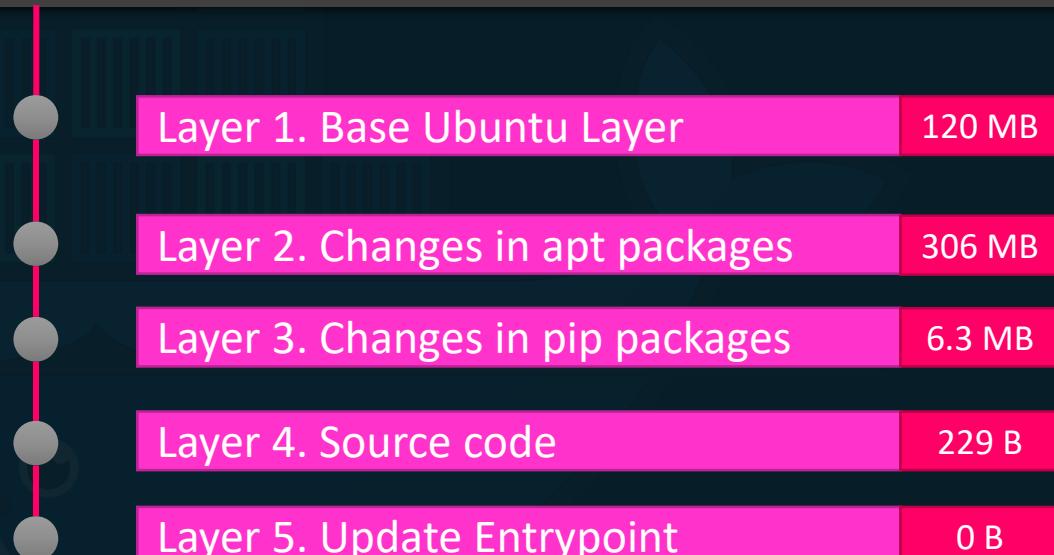
RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY app2.py /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app2.py flask run
```

```
docker build Dockerfile2 -t mmumshad/my-custom-app-2
```



# Layered architecture

Container Layer

**Read Write**

Layer 6. Container Layer

```
docker run mmumshad/my-custom-app
```

Image Layers

**Read Only**

Layer 5. Update Entrypoint with “flask” command

Layer 4. Source code

Layer 3. Changes in pip packages

Layer 2. Changes in apt packages

Layer 1. Base Ubuntu Layer

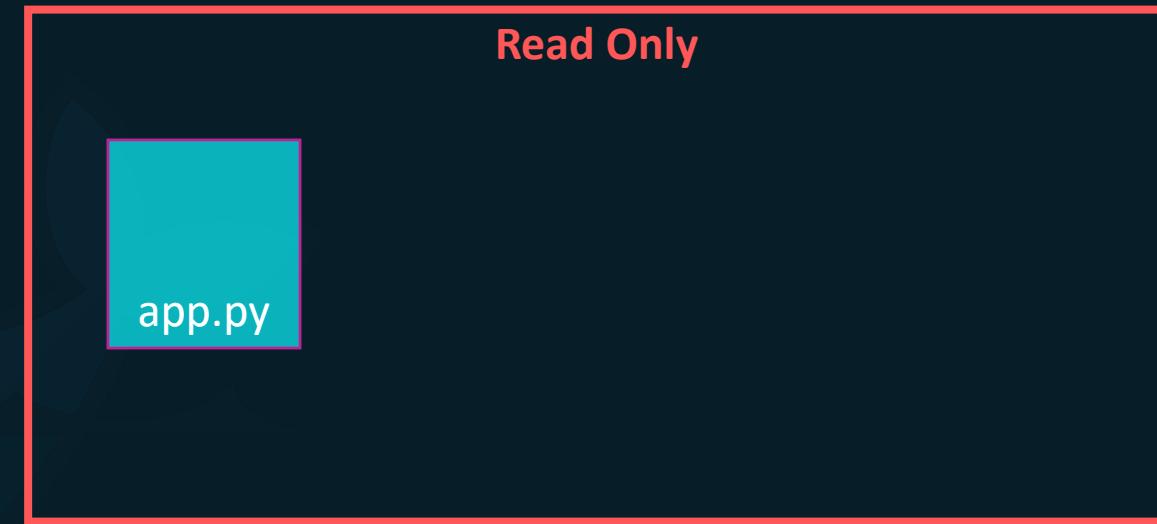
```
docker build Dockerfile -t mmumshad/my-custom-app
```

# COPY-ON-WRITE

Container Layer

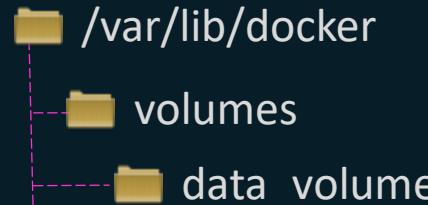


Image Layers



# volumes

```
docker volume create data_volume
```

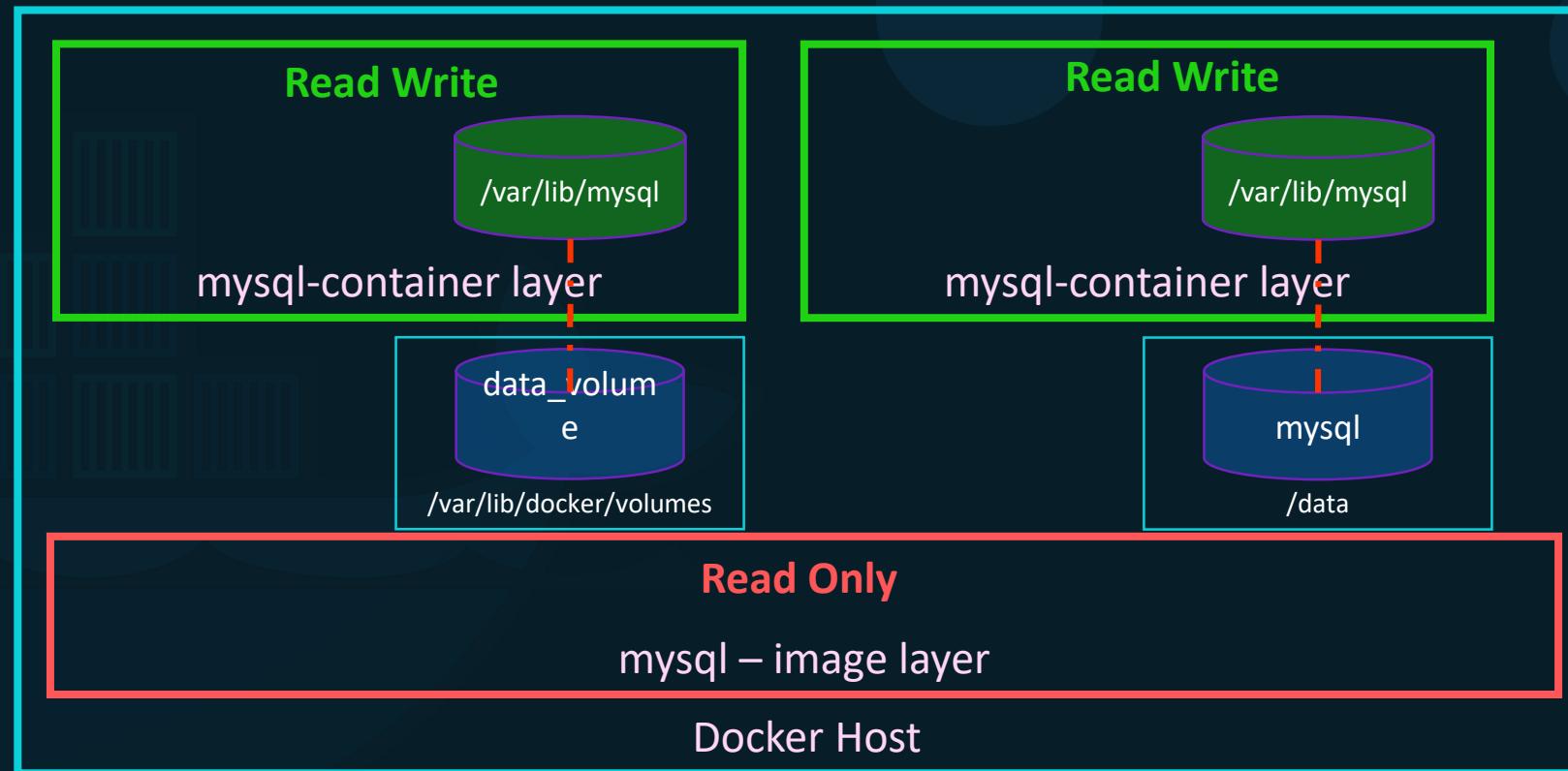


```
docker run -v data_volume:/var/lib/mysql mysql
```

```
docker run -v data_volume2:/var/lib/mysql mysql
```

```
docker run -v /data/mysql:/var/lib/mysql mysql
```

```
docker run \  
  --mount type=bind,source=/data/mysql,target=/var/lib/mysql mysql
```



# Storage drivers

- AUFS
- ZFS
- BTRFS
- Device Mapper
- Overlay
- Overlay2



# d o c k e r compose

# Docker compose

```
docker run mmumshad/simple-webapp
```

```
docker run mongodb
```

```
docker run redis:alpine
```

```
docker run ansible
```

docker-compose.yml

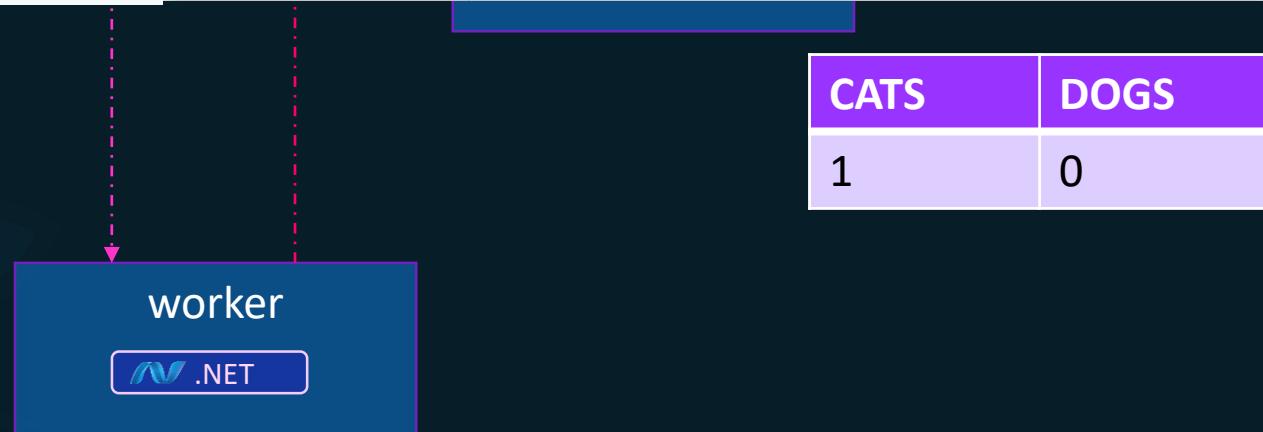
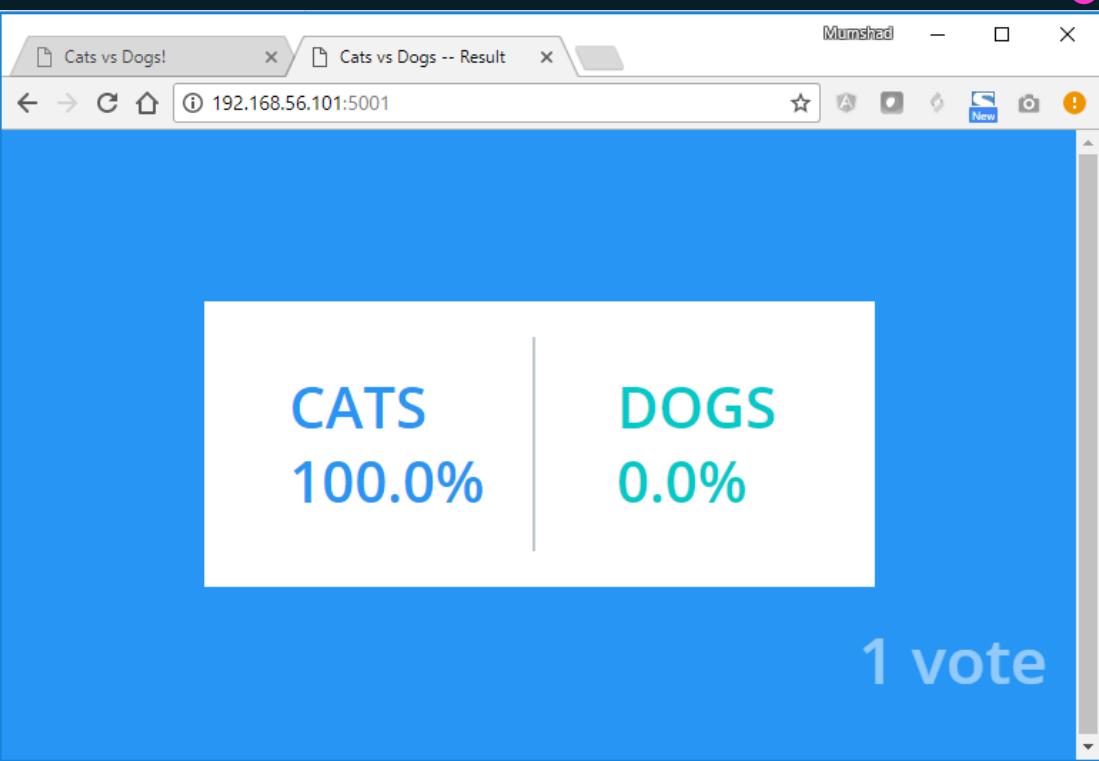
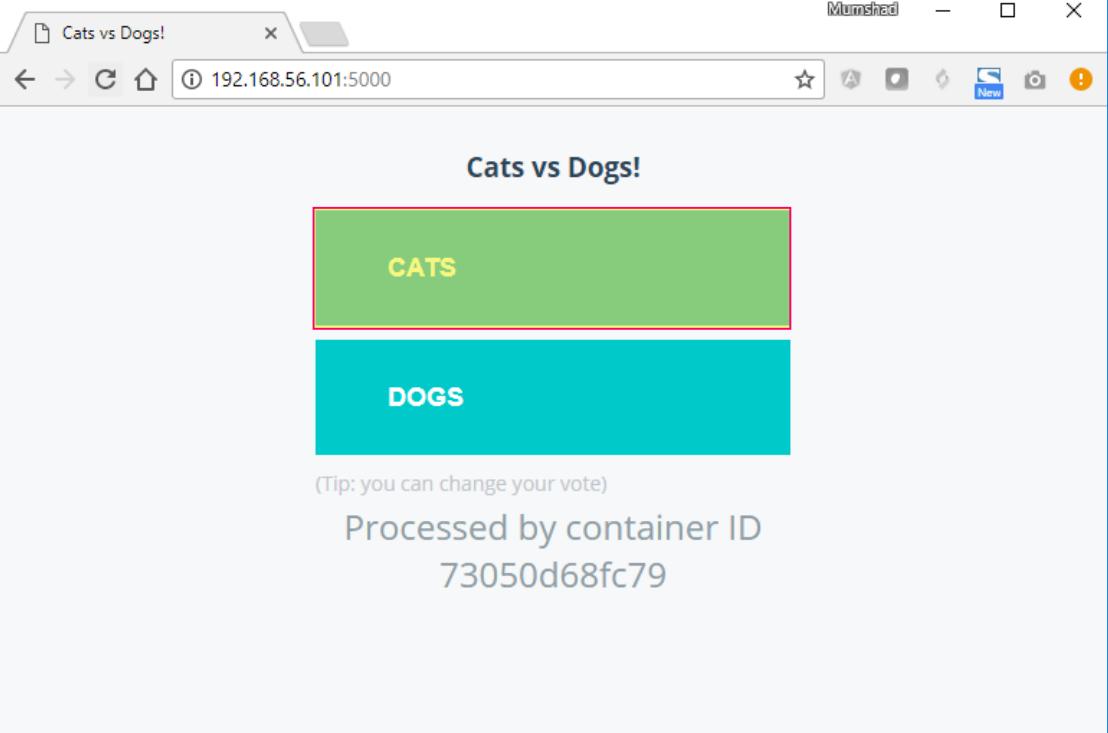
```
services:  
  web:  
    image: "mmumshad/simple-webapp"  
  database:  
    image: "mongodb"  
  messaging:  
    image: "redis:alpine"  
  orchestration:  
    image: "ansible"
```

```
docker-compose up
```



Public Docker registry - dockerhub





# docker run --links

```
docker run -d --name=redis redis
```

```
docker run -d --name=db
```

```
docker run -d --name=vote -p 5000:80 --link redis:redis
```

```
docker run -d --name=result -p 5001:80 --link db:db
```

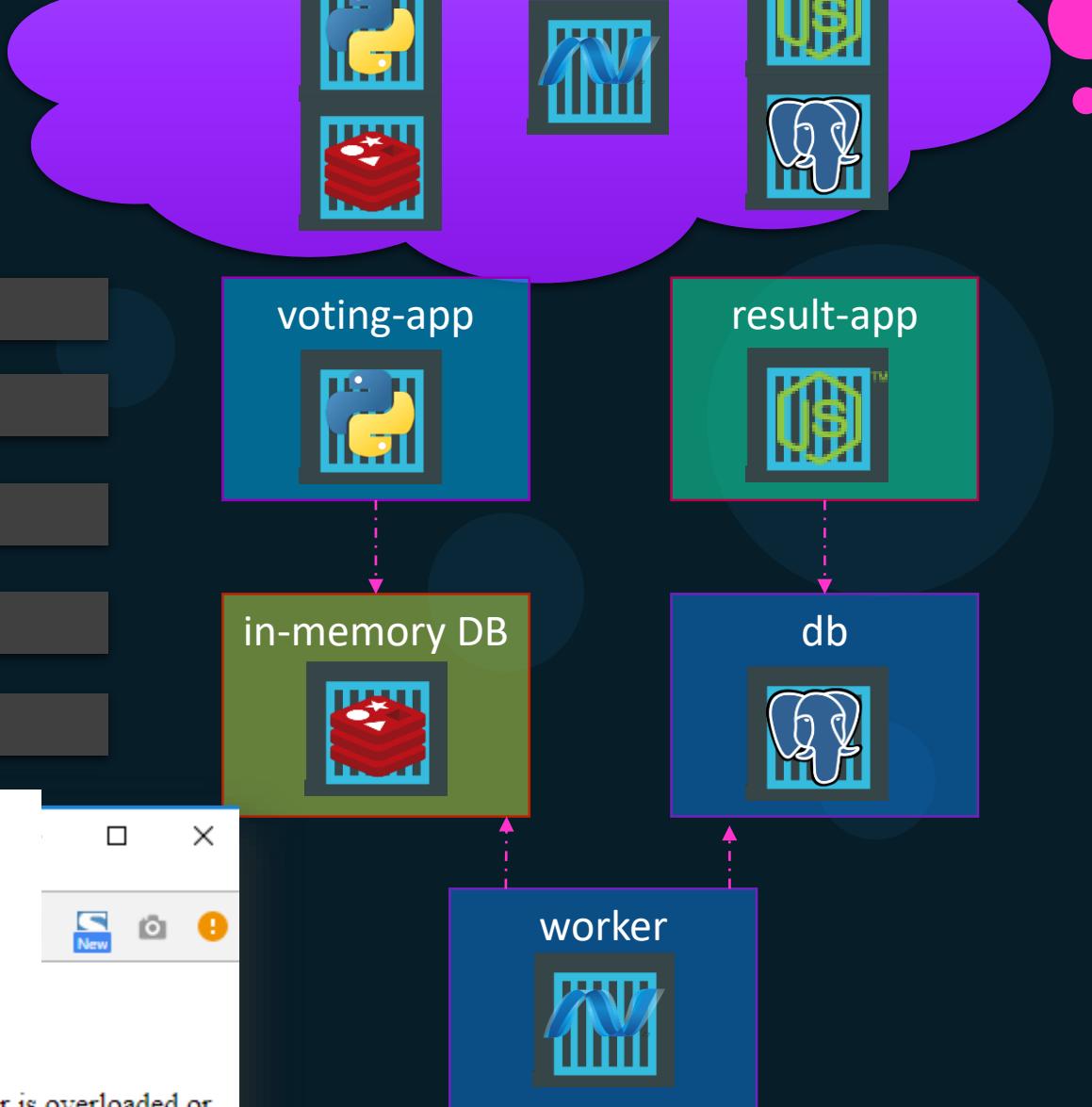
```
docker run -d --name=worker --link db:db --link redis:redis
```

The terminal shows the execution of five Docker commands to run a voting application, a result application, and a worker application, each linked to a Redis instance and a database instance.

```
try {
    Jedis redis = connectToRedis("redis");
    Connection dbConn = connectToDB("db");

    System.err.println("Watching vote queue");
}

The server encountered an error while attempting to handle this request.
There is an error in the configuration of the server.
127.0.0.1      localhost
::1      localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
172.17.0.2      redis 89cd8eb563da
172.17.0.3      ebcae9eb46bf
```



Deprecation Warning

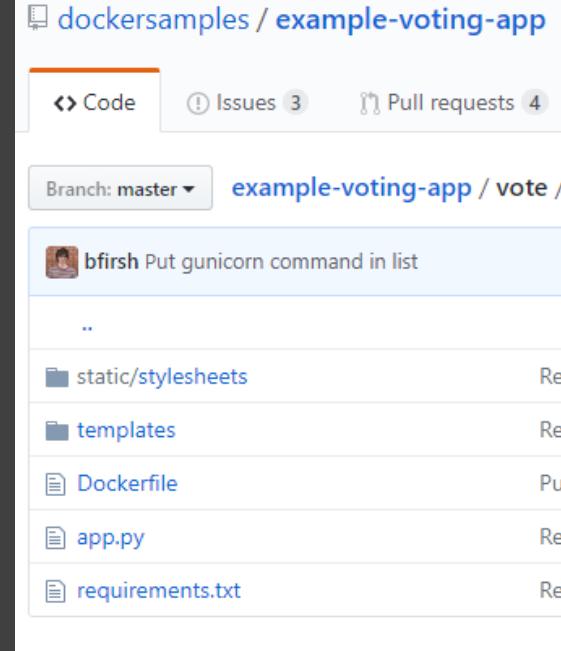
# Docker compose - build

docker-compose.yml

```
redis:  
  image: redis  
db:  
  image: postgres:9.4  
vote:  
  image: voting-app  
  ports:  
    - 5000:80  
  links:  
    - redis  
result:  
  image: result  
  ports:  
    - 5001:80  
  links:  
    - db  
worker:  
  image: worker  
  links:  
    - db  
    - redis
```

docker-compose.yml

```
redis:  
  image: redis  
db:  
  image: postgres:9.4  
vote:  
  build: ./vote  
  ports:  
    - 5000:80  
  links:  
    - redis  
result:  
  build: ./result  
  ports:  
    - 5001:80  
  links:  
    - db  
worker:  
  build: ./worker  
  links:  
    - db  
    - redis
```



# Docker compose - versions

docker-compose.yml

```
redis:  
  image: redis  
  
db:  
  image: postgres:9.4  
  
vote:  
  image: voting-app  
  ports:  
    - 5000:80  
  links:  
    - redis
```

version: 1

docker-compose.yml

```
version: 2  
services:  
  redis:  
    image: redis  
  db:  
    image: postgres:9.4  
  vote:  
    image: voting-app  
    ports:  
      - 5000:80  
    depends_on:  
      - redis
```

version: 2

docker-compose.yml

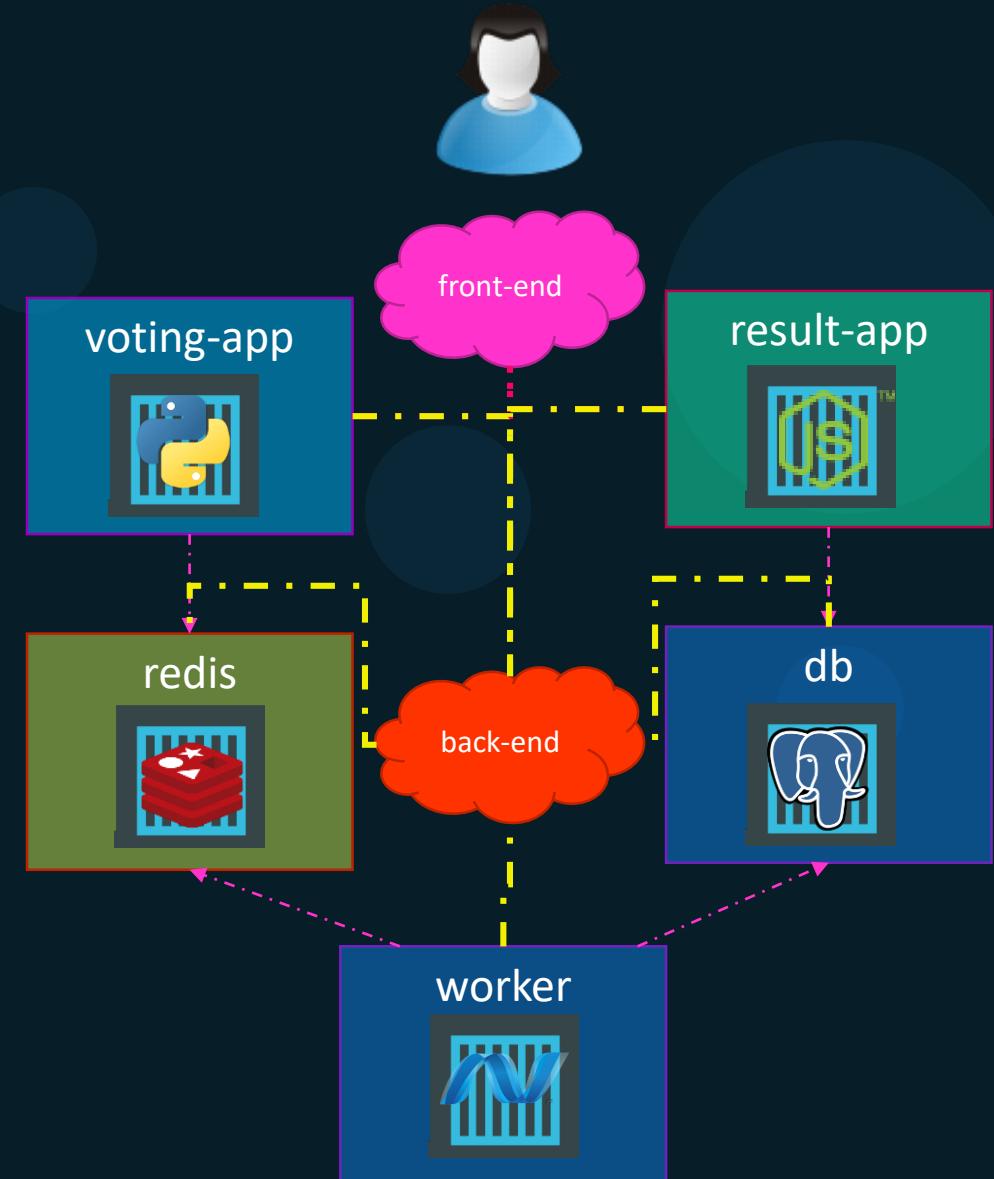
```
version: 3  
services:
```

version: 3

# Docker compose

docker-compose.yml

```
version: 2
services:
  redis:
    image: redis
    networks:
      - back-end
  db:
    image: postgres:9.4
    networks:
      - back-end
  vote:
    image: voting-app
    networks:
      - front-end
      - back-end
  result:
    image: result
    networks:
      - front-end
      - back-end
networks:
  front-end:
  back-end:
```



# d o c k e r registry

# Image

```
▶ docker run nginx
```

# Image

**image:** docker.io/nginx/nginx

Registry      User/ Image/  
Account Repository

gcr.io/kubernetes-e2e-test-images/dnsutils

# Private Registry

```
▶ docker login private-registry.io
```

Login with your Docker ID to push and pull images from Docker Hub. If you don't have a Docker ID, head over to <https://hub.docker.com> to create one.

**Username:** registry-user

**Password:**

WARNING! Your password will be stored unencrypted in /home/vagrant/.docker/config.json.

Login Succeeded

```
▶ docker run private-registry.io/apps/internal-app
```

# Deploy Private Registry

```
▶ docker run -d -p 5000:5000 --name registry registry:2
```

```
▶ docker image tag my-image localhost:5000/my-image
```

```
▶ docker push localhost:5000/my-image
```

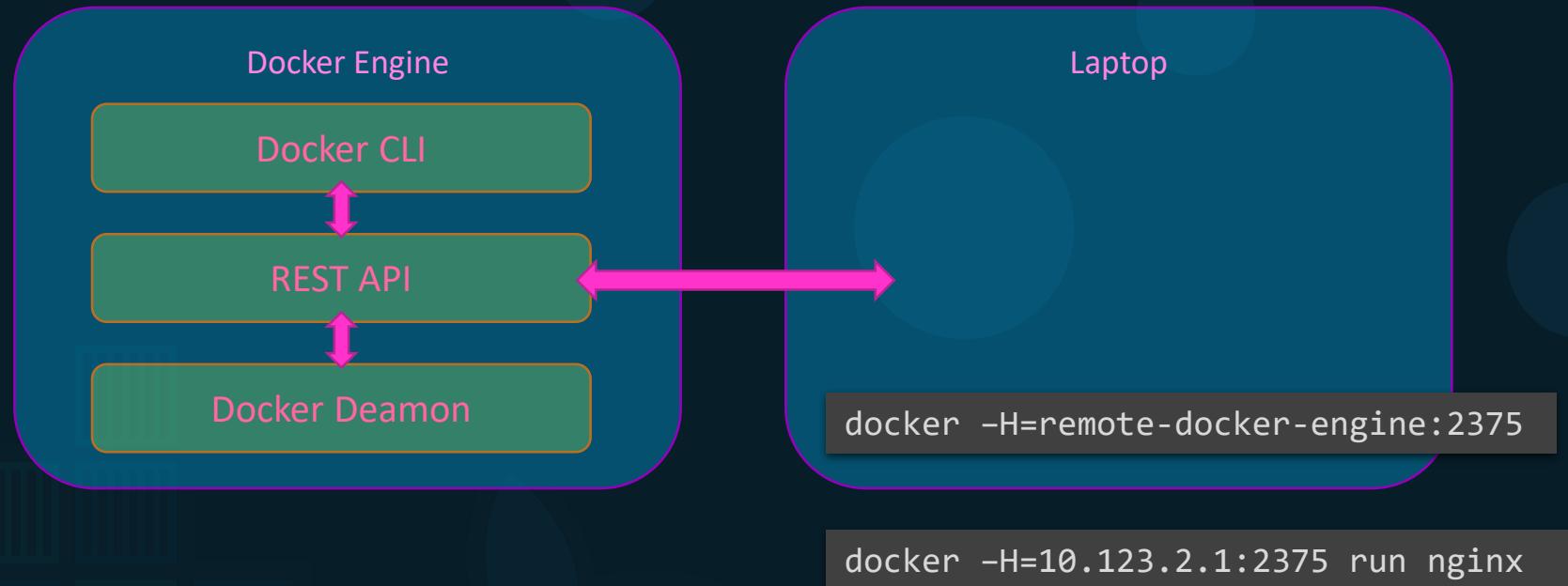
```
▶ docker pull localhost:5000/my-image
```

```
▶ docker pull 192.168.56.100:5000/my-image
```

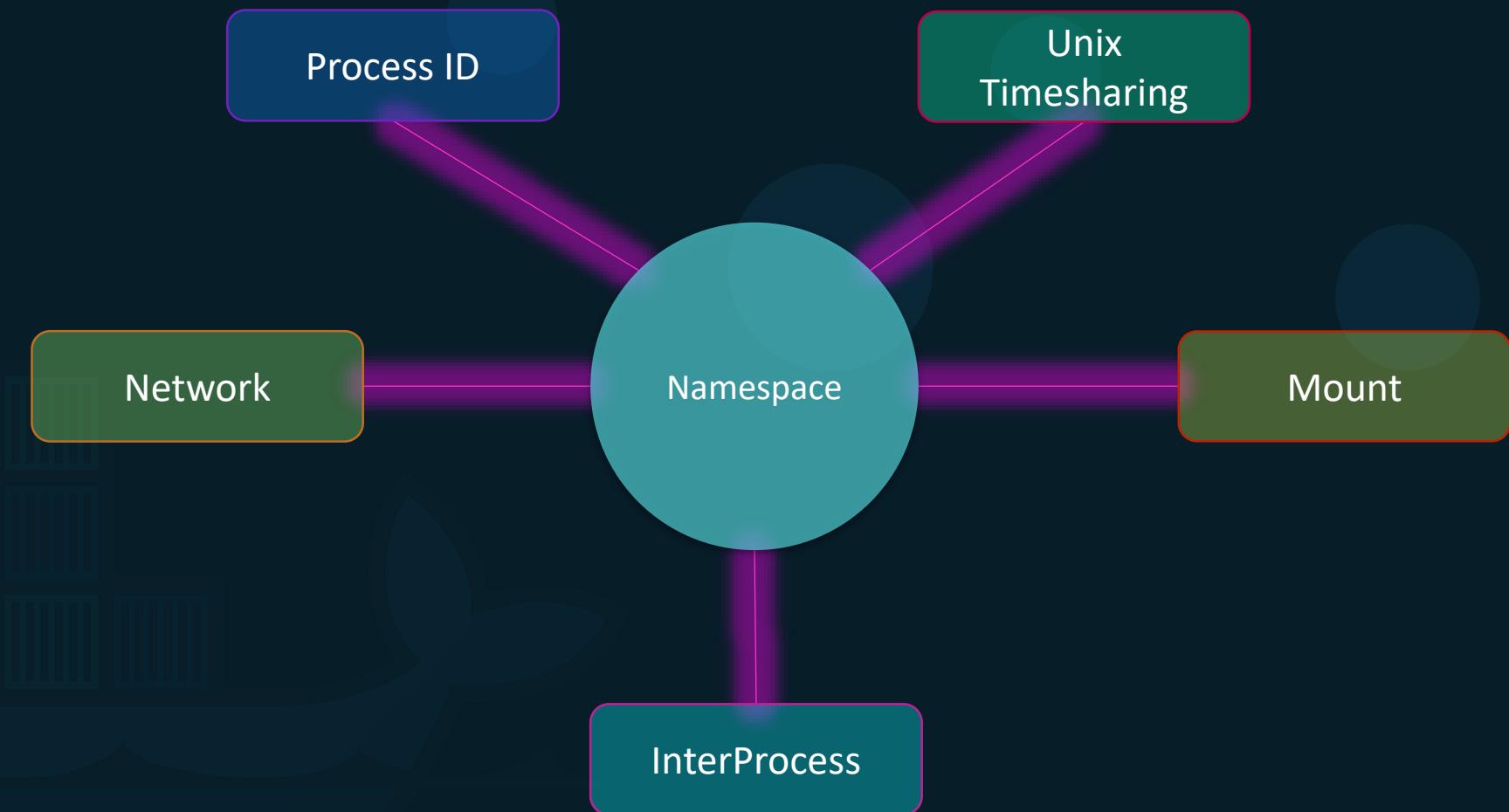


# d o c k e r engine

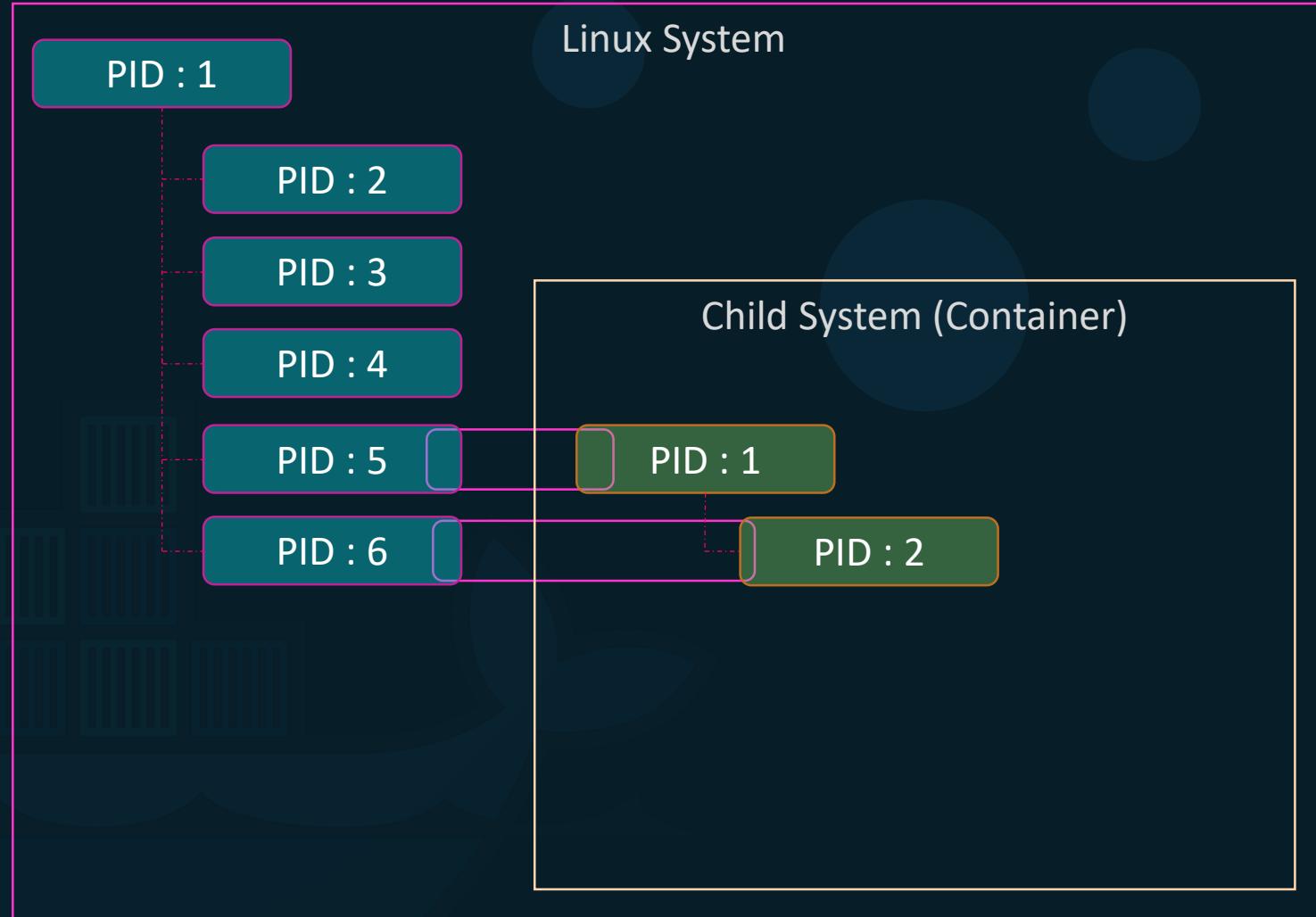
# Docker Engine



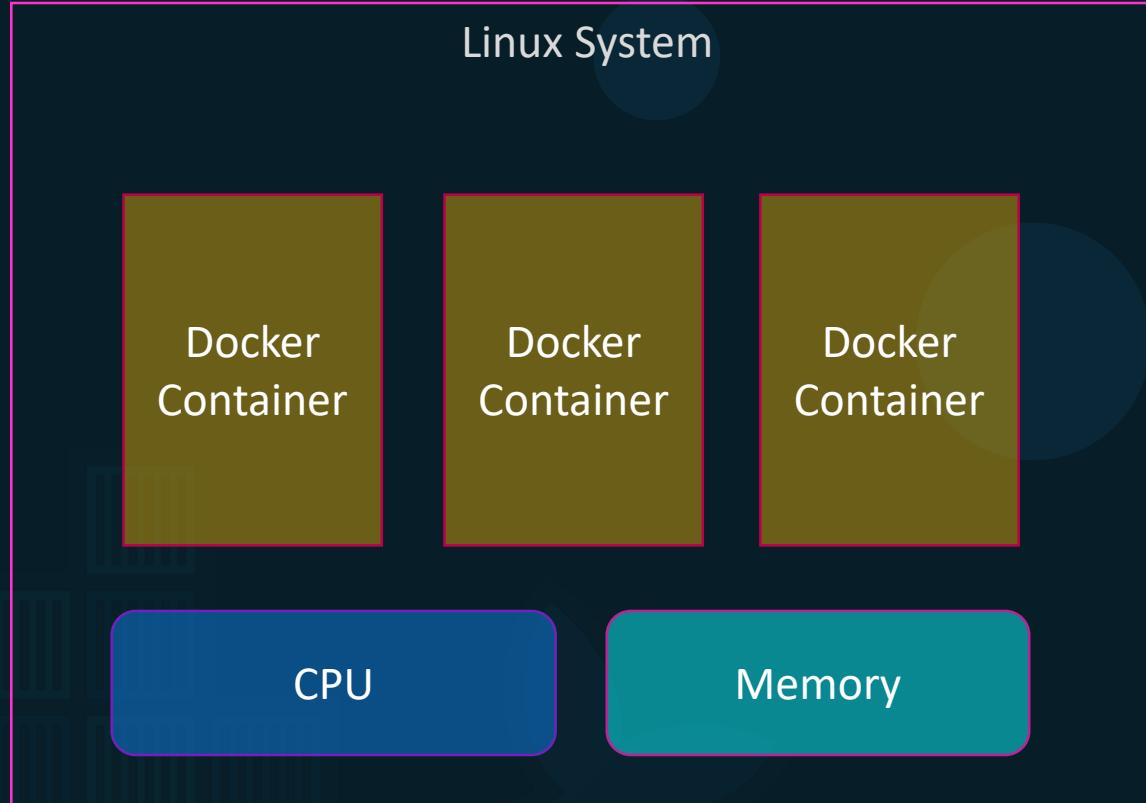
# containerization



# Namespace - PID



# cgroups



```
docker run --cpus=.5 ubuntu
```

```
docker run --memory=100m ubuntu
```



# d o c k e r

# On Windows

# Docker on windows

1. Docker on Windows using Docker Toolbox
2. Docker Desktop for Windows

# 1. Docker toolbox



- 64-bit operating
- Windows 7 or higher.
- Virtualization is enabled



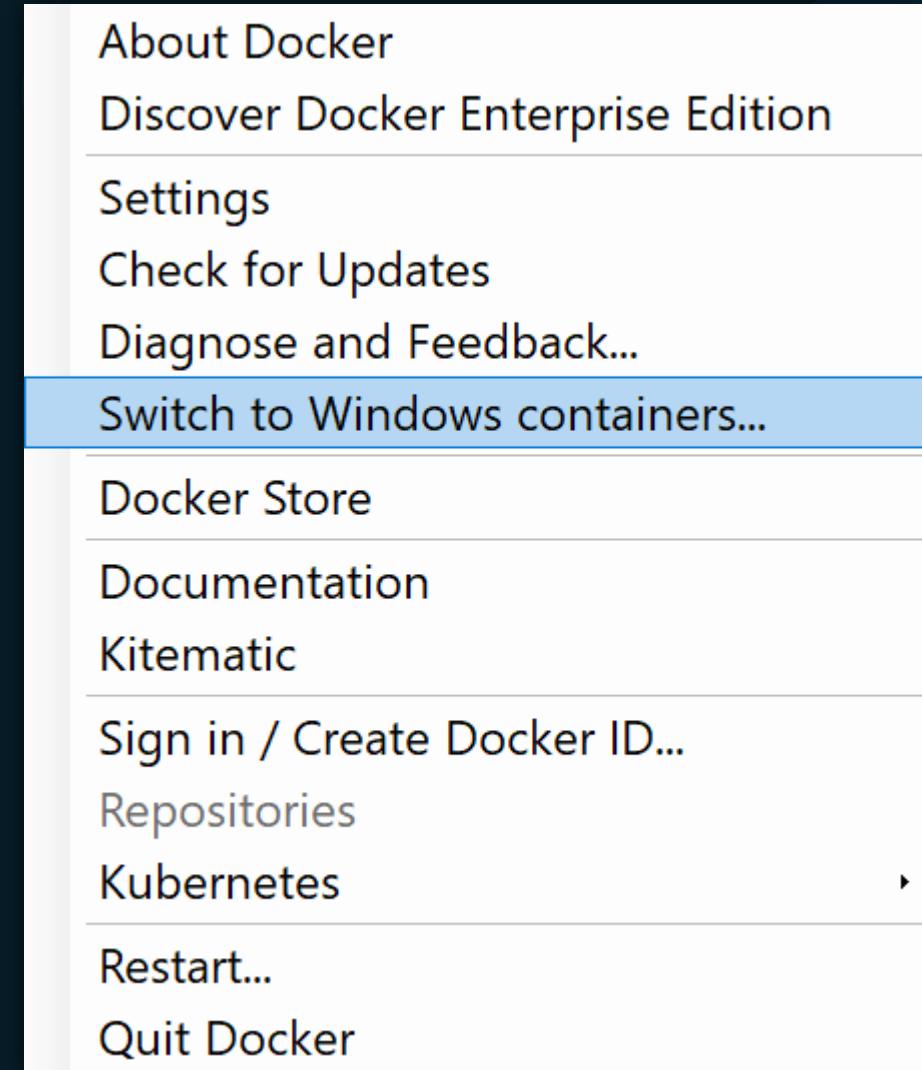
- Oracle Virtualbox
- Docker Engine
- Docker Machine
- Docker Compose
- Kitematic GUI

## 2. Docker Desktop for Windows



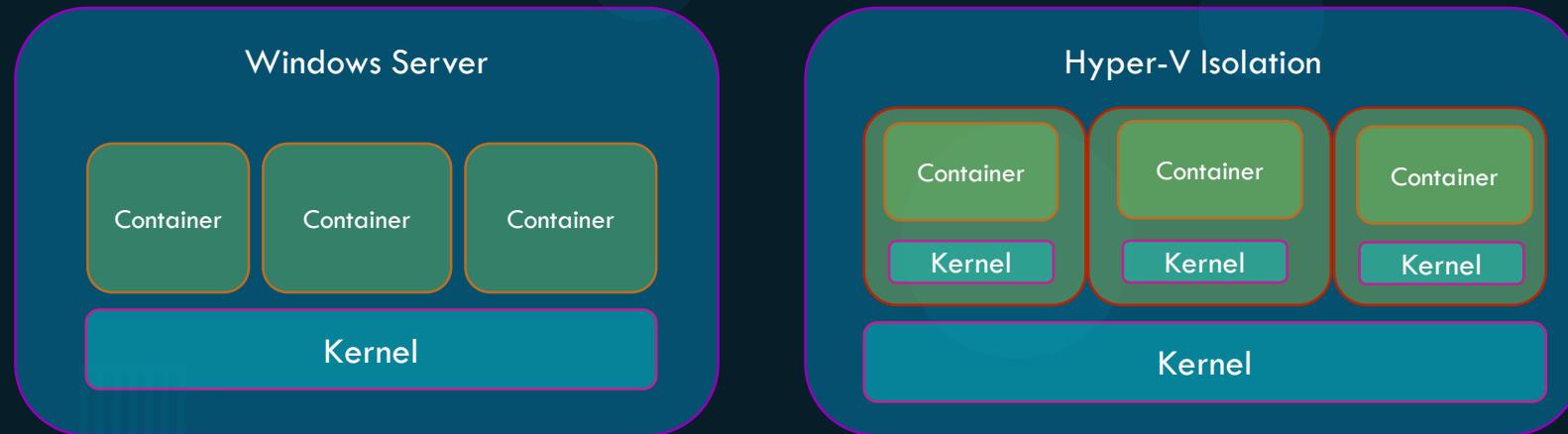
Support: Windows 10 Enterprise/Professional Edition  
Windows Server 2016

Linux Containers (Default)  
Or  
Windows Containers



# Windows containers

## Container Types:

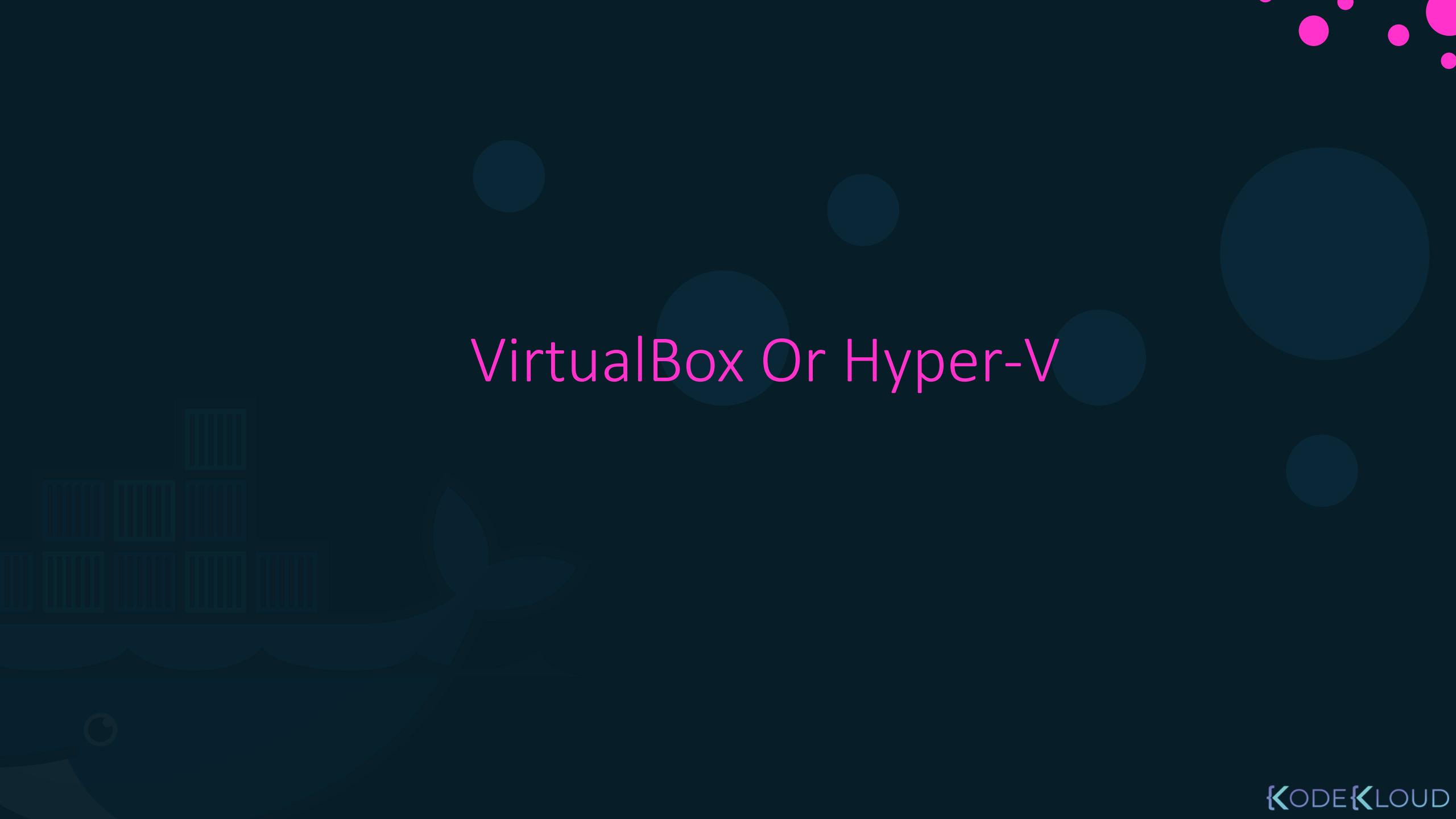


## Base Images:

- Windows Server Core
- Nano Server

## Support

- Windows Server 2016
- Nano Server
- Windows 10 Professional and Enterprise (Hyper-V Isolated Containers)



# VirtualBox Or Hyper-V



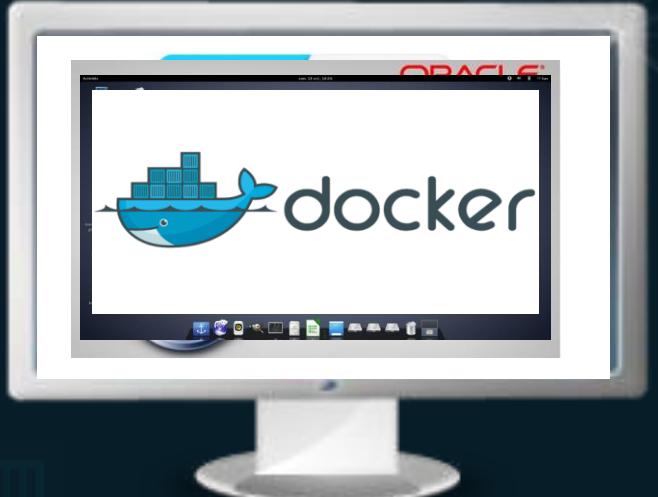
# d o c k e r

# On Mac

# Docker on Mac

1. Docker on Mac using Docker Toolbox
2. Docker Desktop for Mac

# 1. Docker toolbox

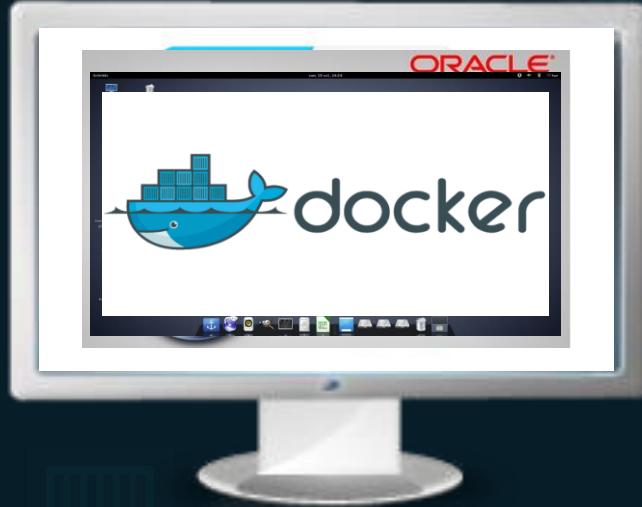


- macOS 10.8 “Mountain Lion” or newer



- Oracle Virtualbox
- Docker Engine
- Docker Machine
- Docker Compose
- Kitematic GUI

## 2. Docker Desktop for Mac



HyperKit

Support: macOS Sierra 10.12 or newer  
Mac Hardware - 2010 model or newer

Linux Containers



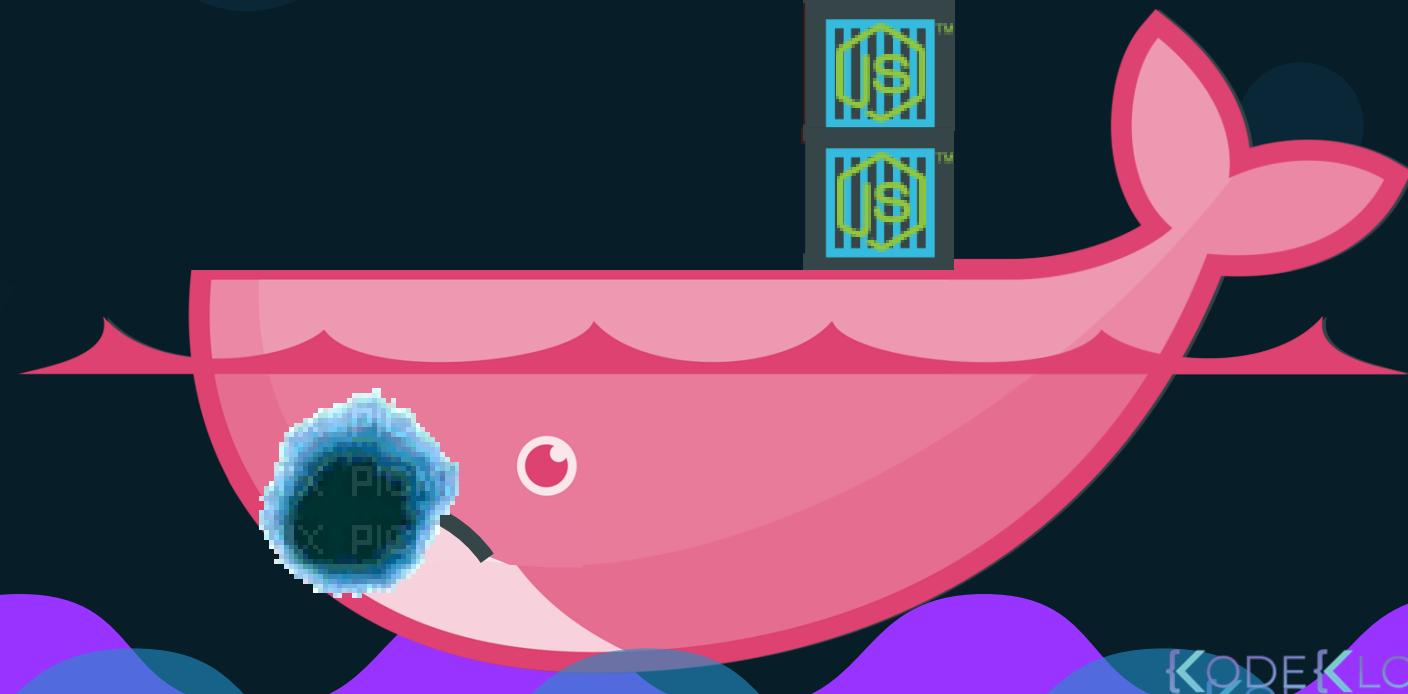
# container orchestration

# Why Orchestrate?



Public Docker registry - dockerhub

```
docker run nodejs  
docker run nodejs  
docker run nodejs  
docker run nodejs
```



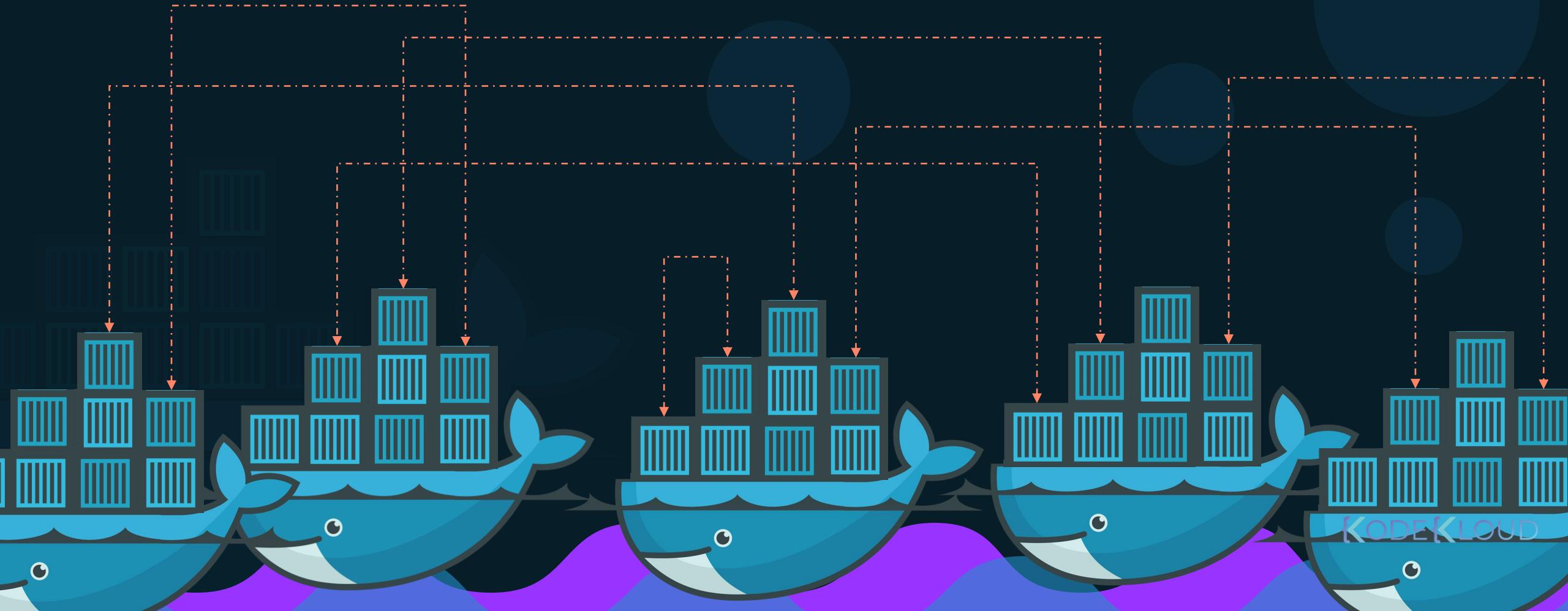
# Container Orchestration

```
docker service create --replicas=100 nodejs
```



# Container Orchestration

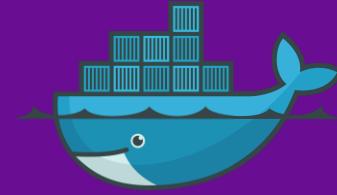
```
docker service create --replicas=100 nodejs
```



# d o c k e r s w a r m



# Solutions



Docker Swarm

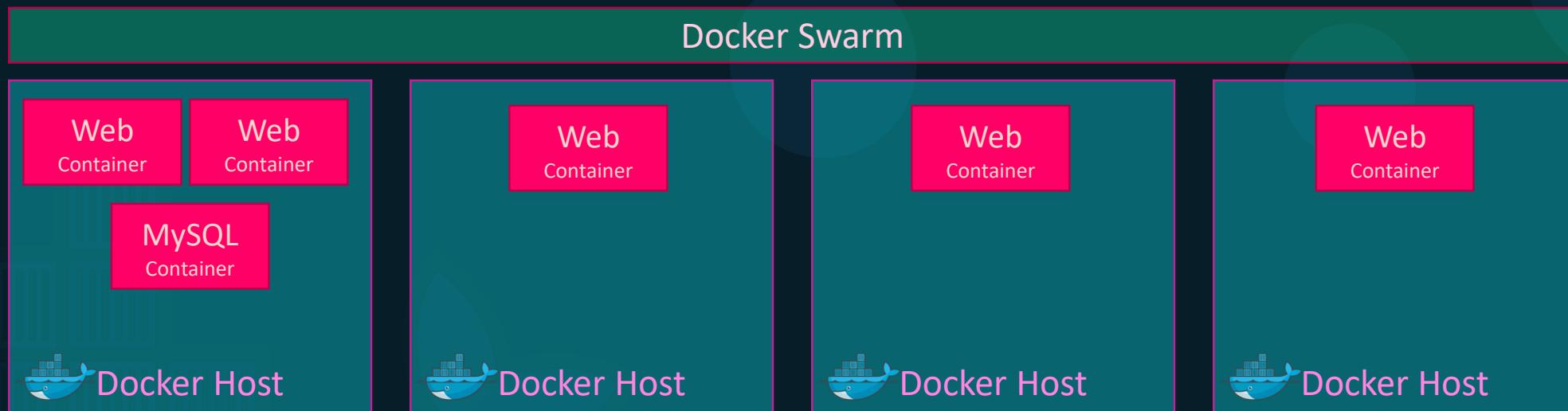


kubernetes



MESOS

# Docker swarm



# Setup swarm

Swarm Manager

```
docker swarm init
```



Node  
Worker

```
docker swarm join  
--token <token>
```



Node  
Worker

```
docker swarm join  
--token <token>
```



Node  
Worker

```
docker swarm join  
--token <token>
```



```
root@osboxes:/root/simple-webapp-docker # docker swarm init --advertise-addr 192.168.1.12  
Swarm initialized: current node (0j76dum2r56p1xfne4ub1ps2c) is now a manager.
```

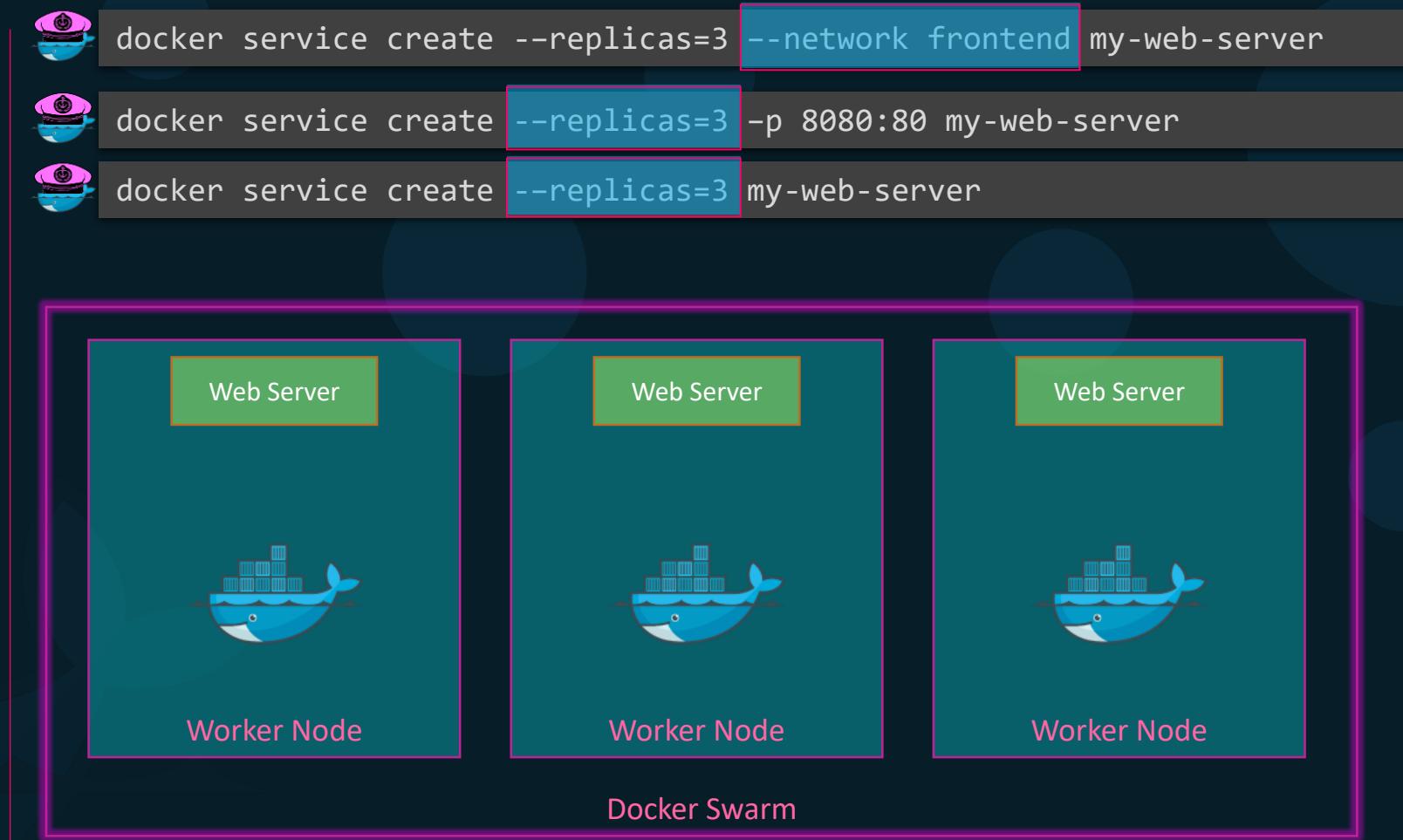
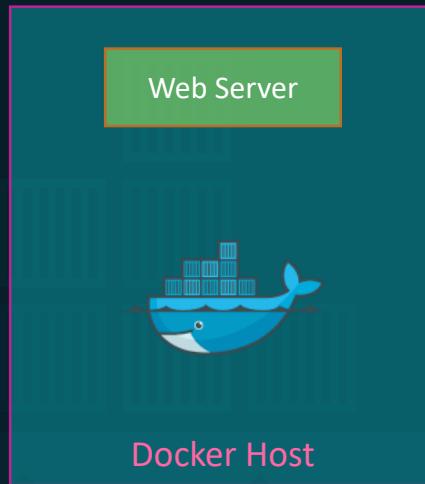
To add a worker to this swarm, run the following command:

```
docker swarm join --token SWMTKN-1-35va8b3fi5krpdskefqqxgttmulw3z828daucr7y526ne0sgu-2eek9qm33d4lxzoq6we9i8izp 192.16  
8.1.12:2377
```

To add a manager to this swarm, run 'docker swarm join-token manager' and follow the instructions.

# Docker service

```
docker run my-web-server
```



# kubernetes





```
docker run my-web-server
```



```
kubectl rolling-update my-web-server --rollback
```

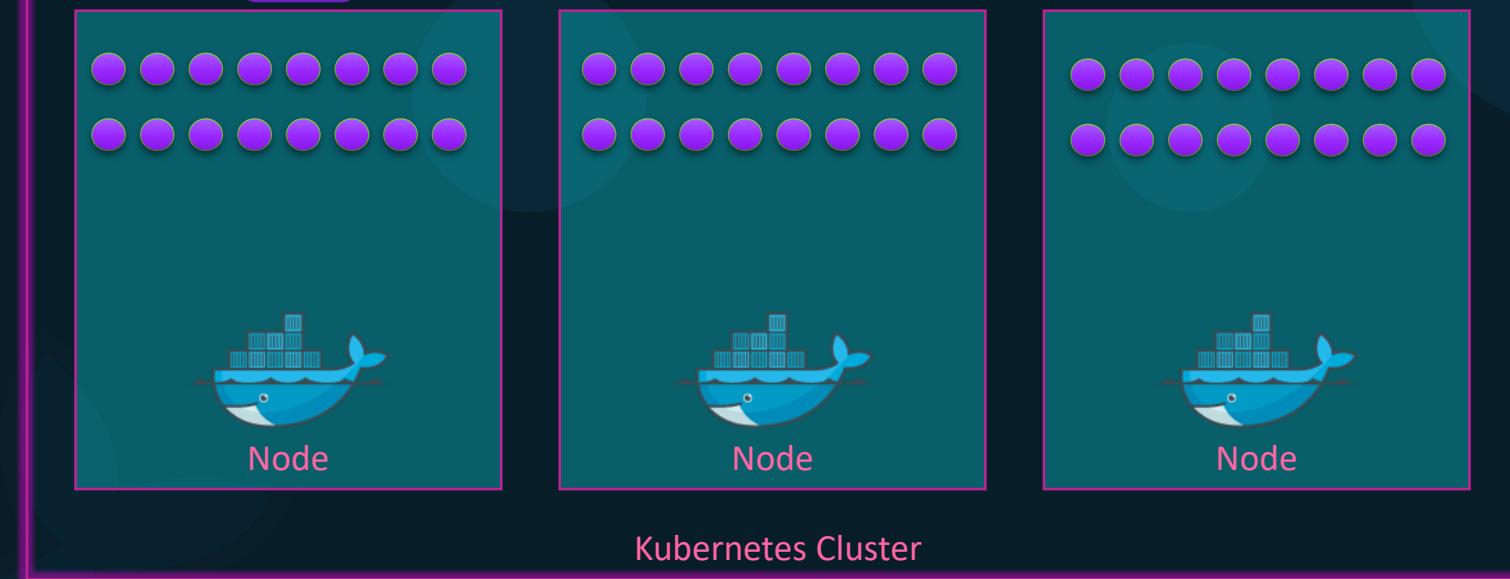
```
kubectl rolling-update my-web-server --image=web-server:2
```

```
kubectl scale --replicas=2000 my-web-server
```

```
kubectl run --replicas=1000 my-web-server
```

A

B



Security

POD AutoScalers

Cluster AutoScalers

Network

weaveworks

flannel

cilium  
SCALEIO

vmware  
NSX



Storage

ceph

GlusterFS

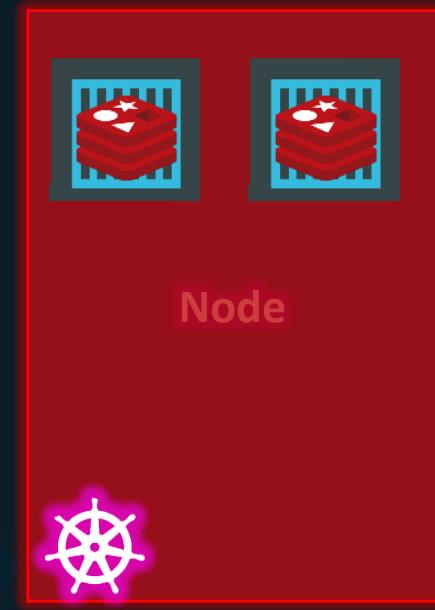
amazon  
webservices™



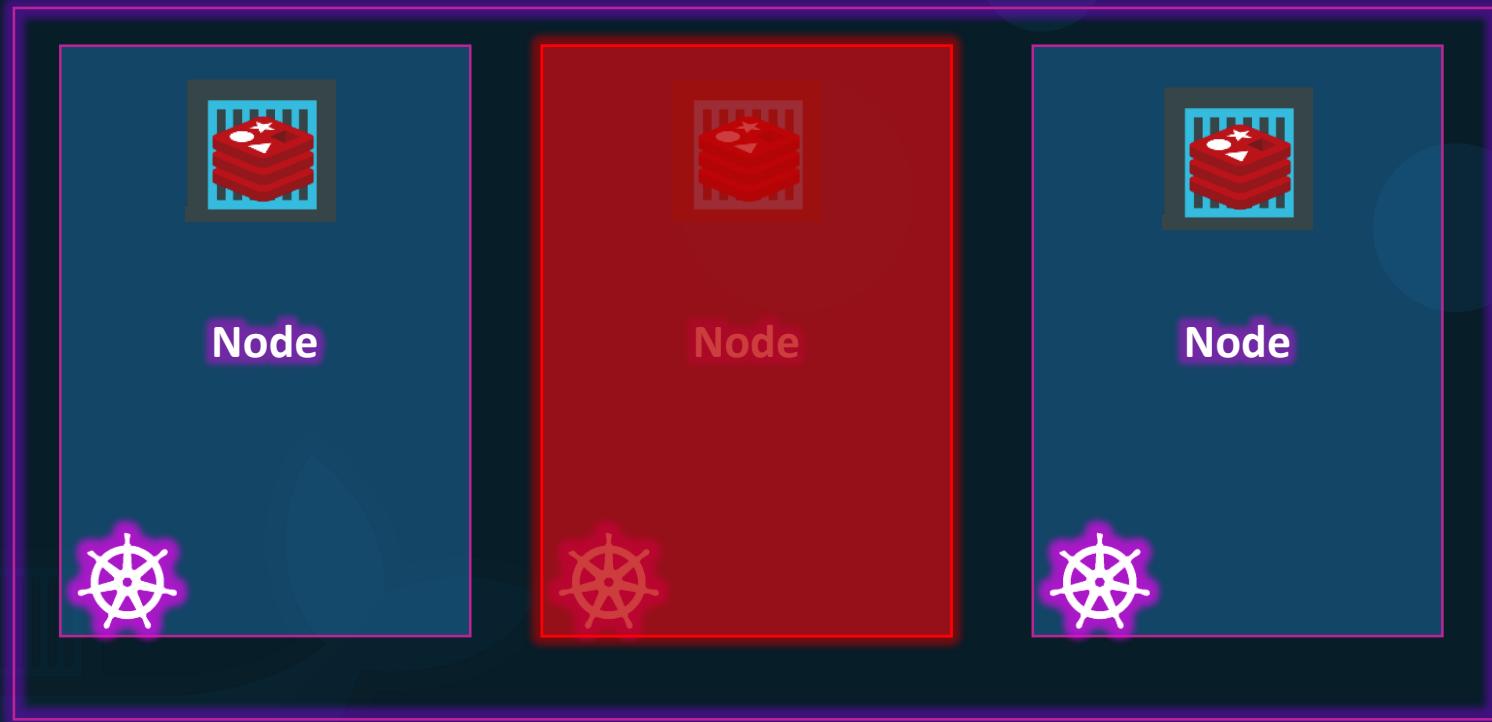
Flocker  
by ClusterHQ

KODE KLOUD

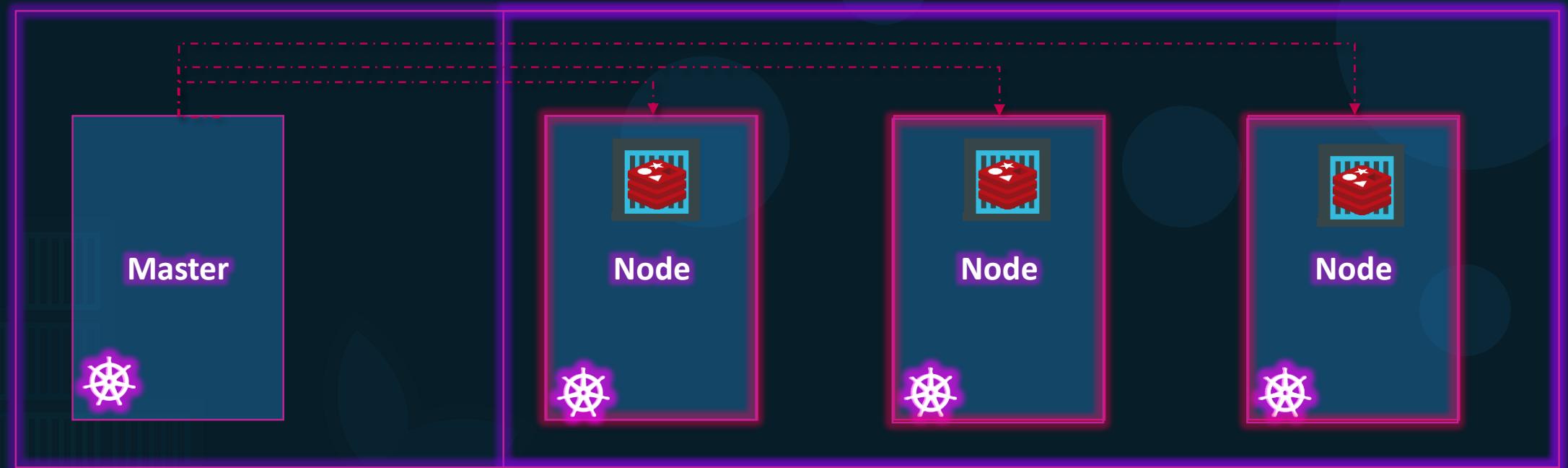
# Nodes (Minions)



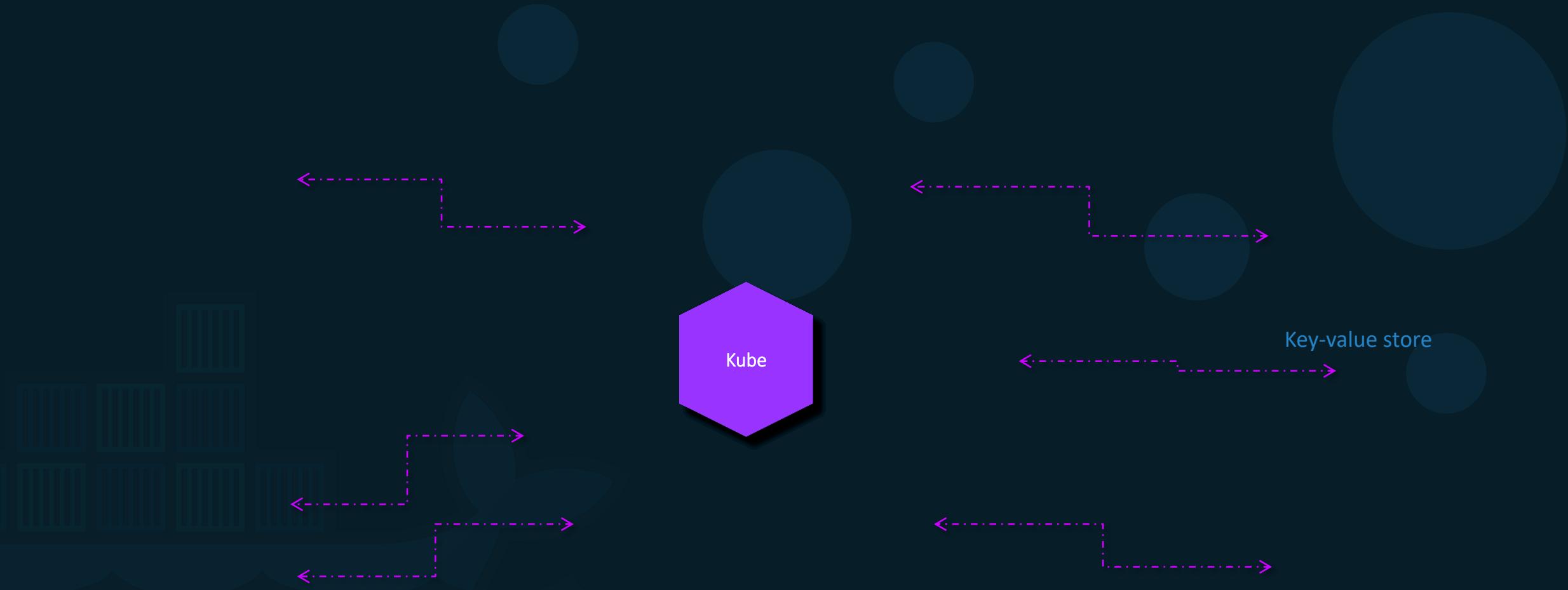
# Cluster



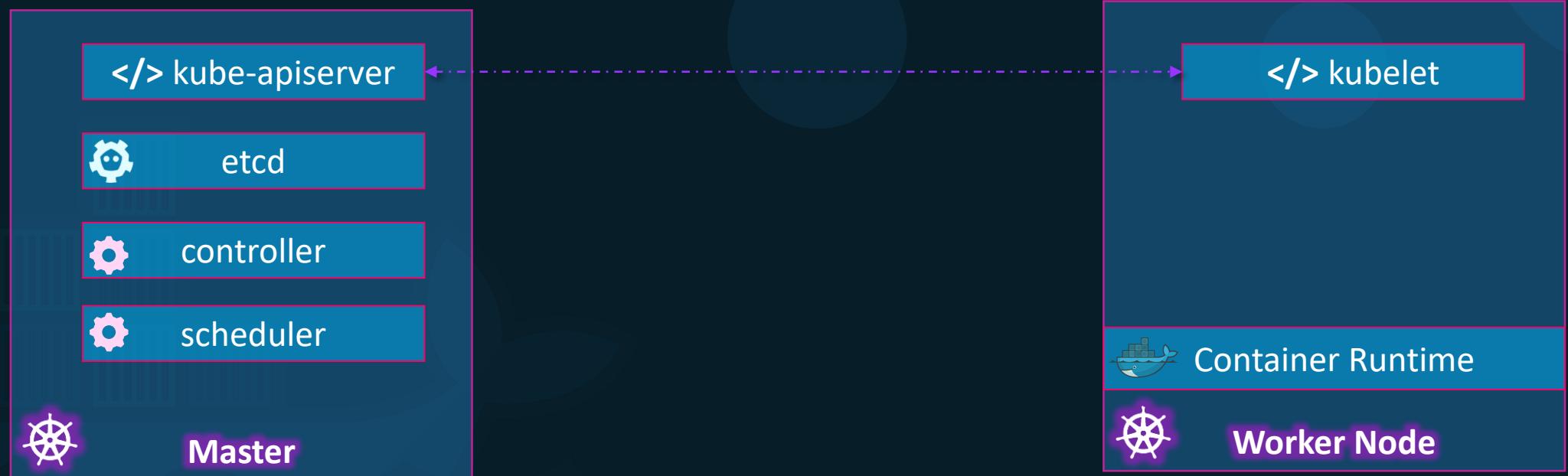
# Master



# Components



# Master vs Worker Nodes



rkt  
CRI-O

# kubectl

```
kubectl run hello-minikube
```

```
kubectl cluster-info
```

```
kubectl get nodes
```

```
kubectl run my-web-app --image=my-web-app --replicas=100
```



# CONCLUSION

# THANK YOU