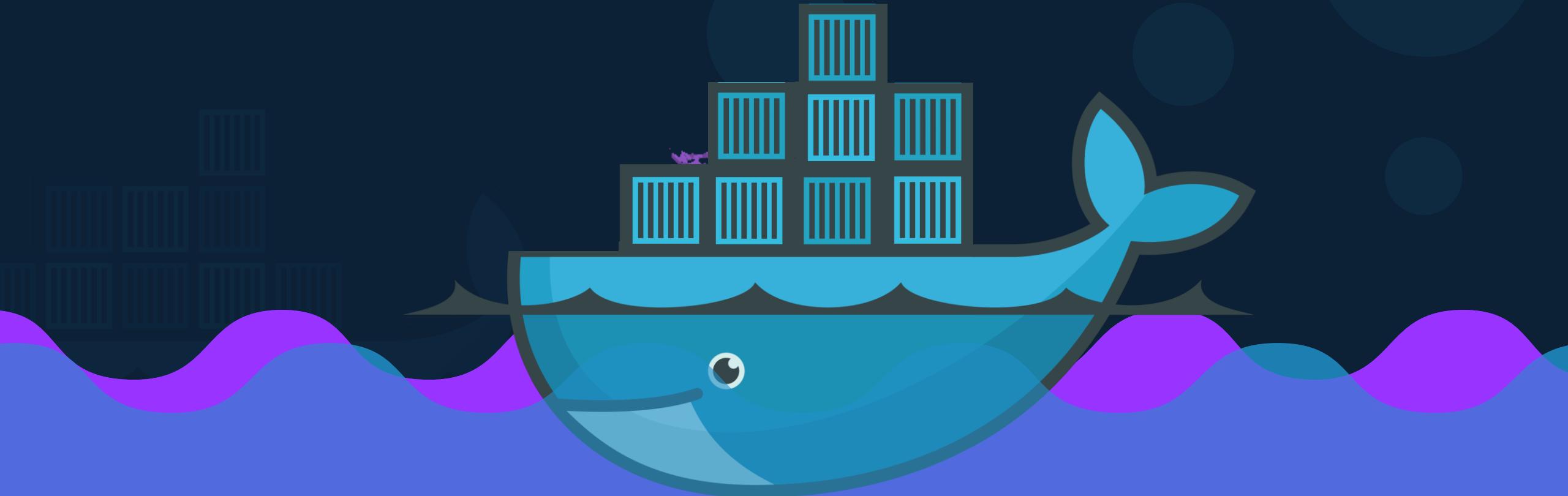


docker®

পরিষি হ্যান্ডনোট

docker

for beginners



SABBIR IMON

Poridhi.io

<https://poridhi.io/>

Objectives

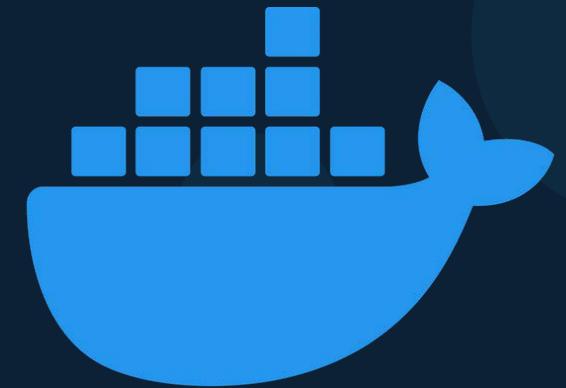
- What are Containers?
- What is Docker?
- Why do you need it?
- What can it do?

- 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®



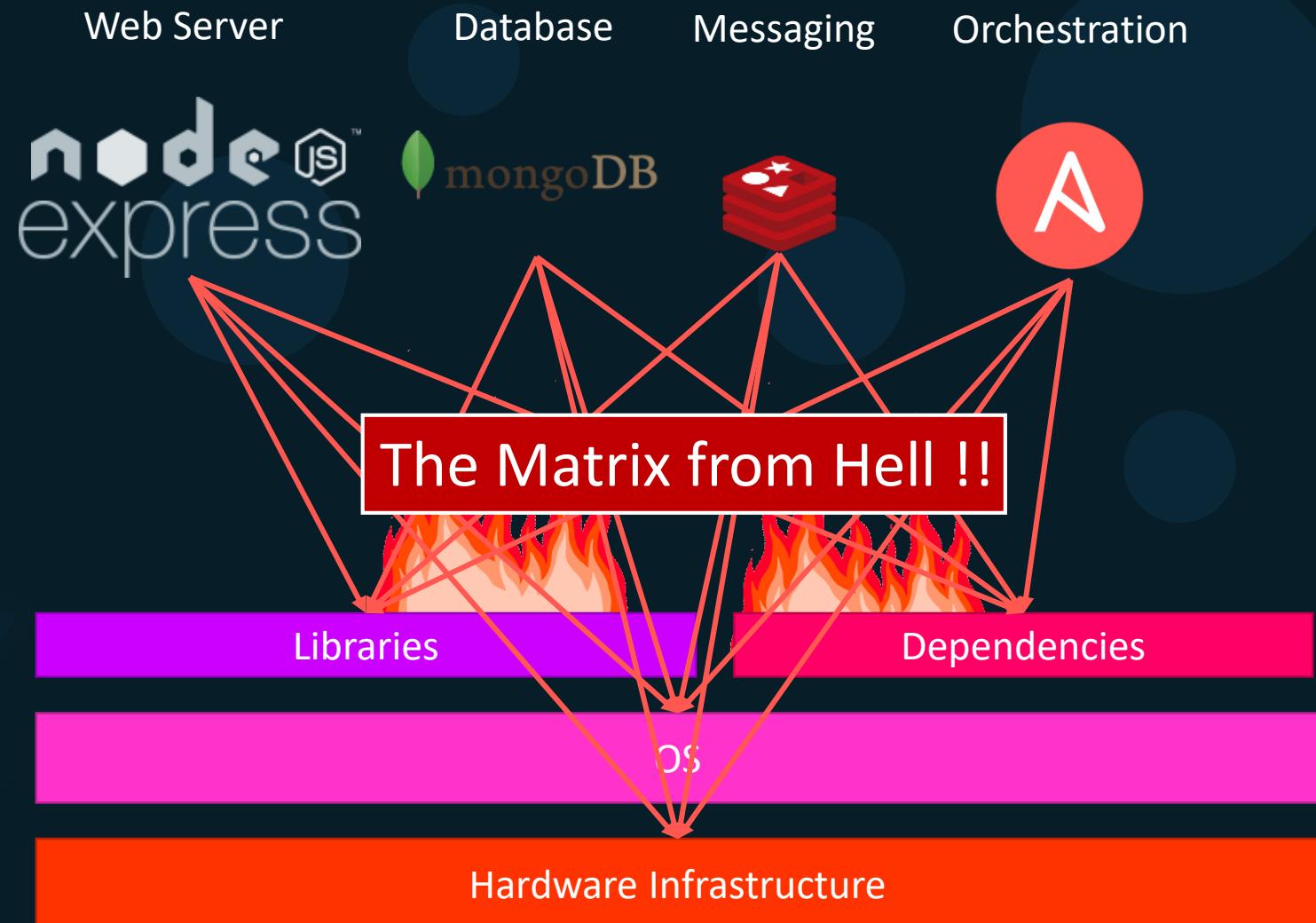


docker

overview

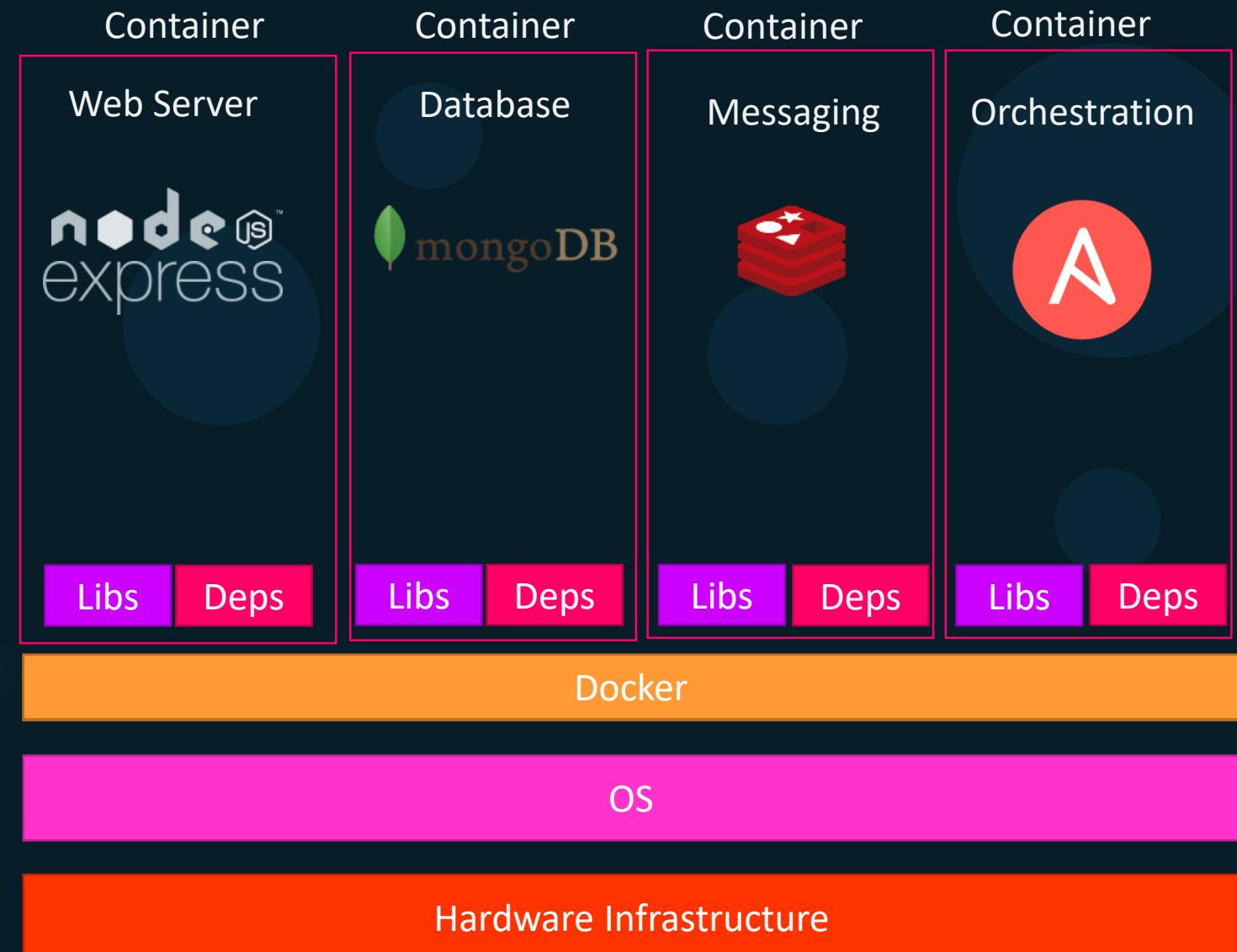
Why do you need docker?

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

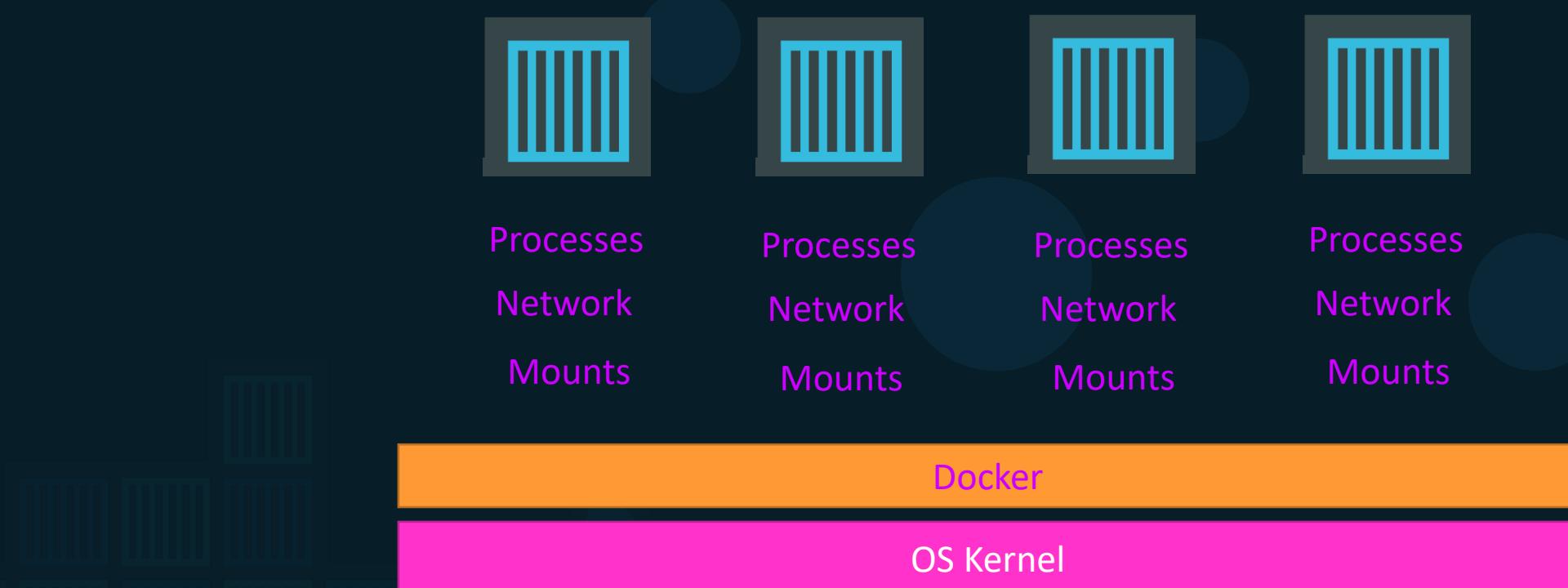


What can it do?

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



What are containers?



Operating System



OS

Software

Software

Software

Software

OS Kernel

Sharing the kernel

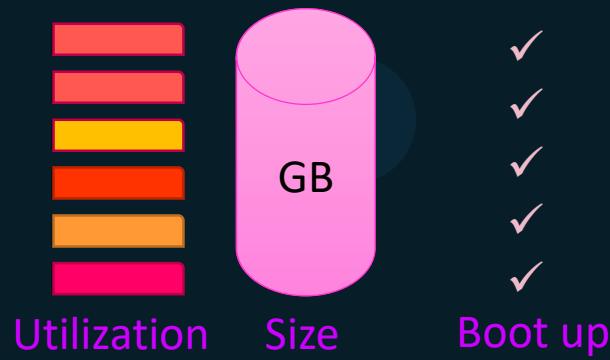


Docker

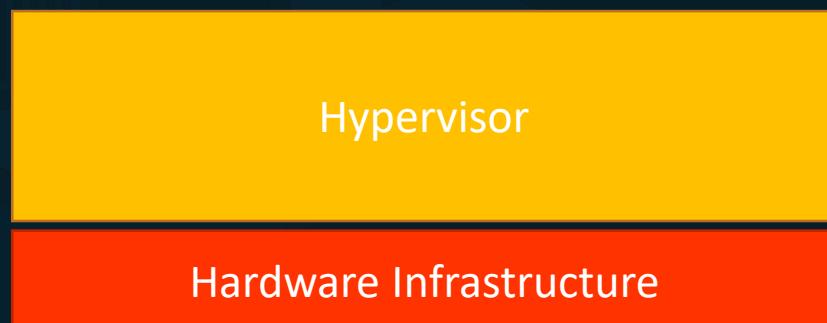
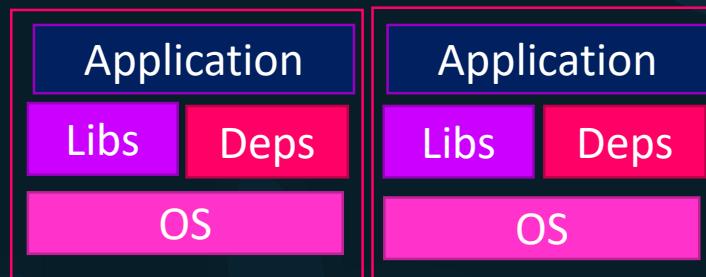


OS - Ubuntu

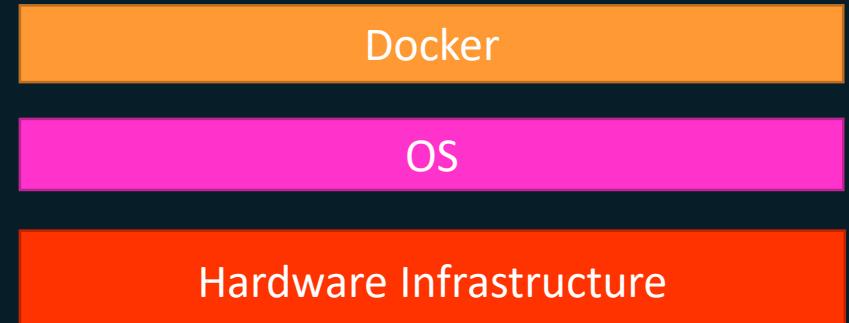
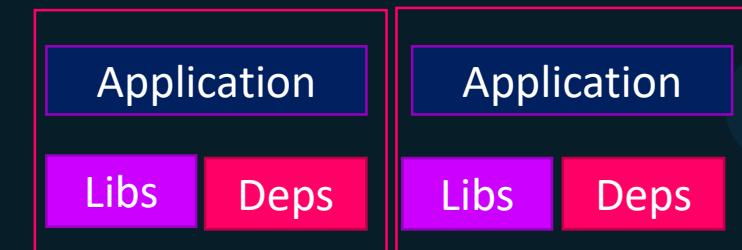
Containers vs Virtual Machines



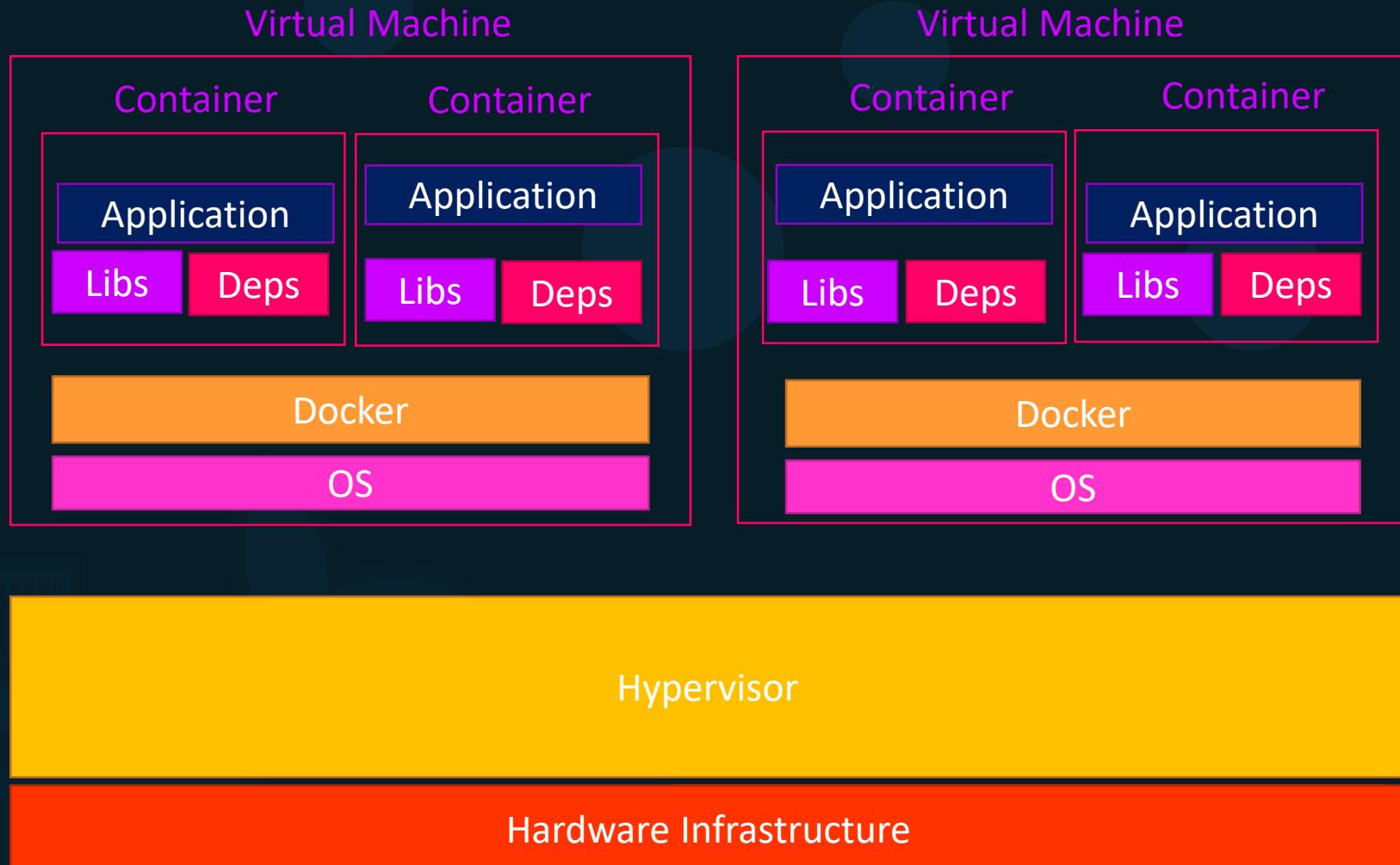
Virtual Machine Virtual Machine



Container Container



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

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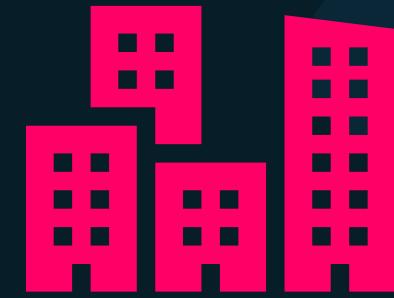
Getting Started

d o c k e r

Docker Editions



Community Edition



Enterprise Edition

Community Edition



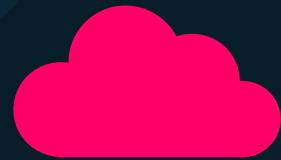
Linux



MAC



Windows



Cloud

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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@sha256:96fb261b66270b900ea5a2c17a26abbfabe95506e73c3a3c65869a6dbe83223a
Deleted: sha256:f68d6e55e06520f152403e6d96d0de5c9790a89b4cf99f4626f68146fa1dbdc
Deleted: sha256:1b0c768769e2bb66e74a205317ba531473781a78b77feef8ea6fd7be7f4044e1
Deleted: sha256:34138fb60020a180e512485fb96fd42e286fb0d86cf1fa2506b11ff6b945b03f
Deleted: sha256:cf5b3c6798f77b1f78bf4e297b27cfa5b6caa982f04caeb5de7d13c255fd7a1e
```

! 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
```

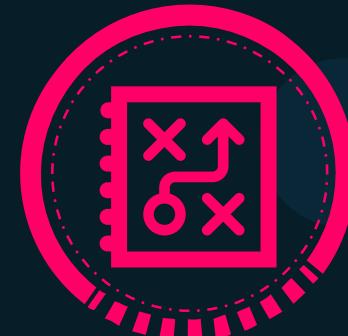
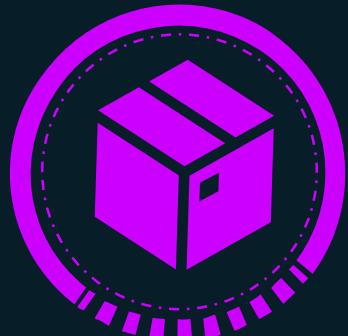
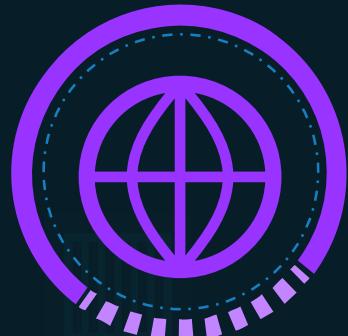
```
▶ docker ps
```

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 porid i/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 porid i/simple-webapp
```

```
a043d40f85fe fa414254e4775f9336ea59e19e5cf597af5c554e0a35a1631118
```

```
▶ docker attach a043d
```

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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: IMON
```

Hello and Welcome IMON!

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

Hello and Welcome !

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

IMON

Hello and Welcome IMON!

```
docker run -it porid i/simple-prompt-docker
```

Welcome! Please enter your name: IMON

Hello and Welcome IMON!

Run – PORT mapping

```
docker run porid i/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 porid i/simple-webapp
```

```
docker run -p 8000:5000 porid i/simple-webapp
```

```
docker run -p 8001:5000 porid i/simple-webapp
```

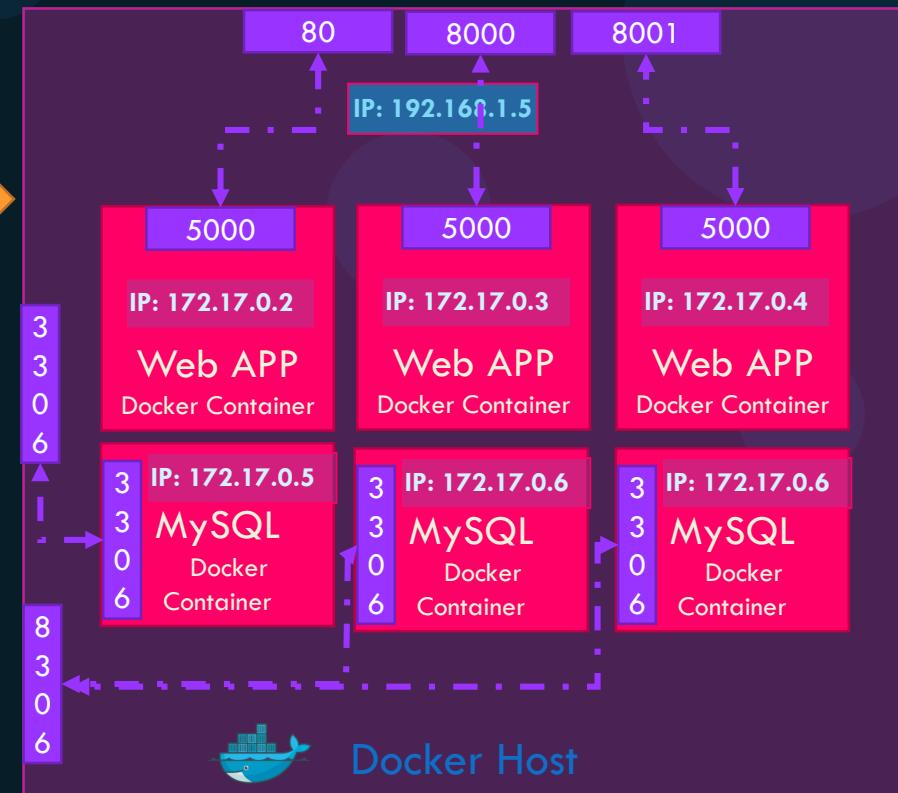
```
docker run -p 3306:3306 mysql
```

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

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



http://192.168.1.5:80



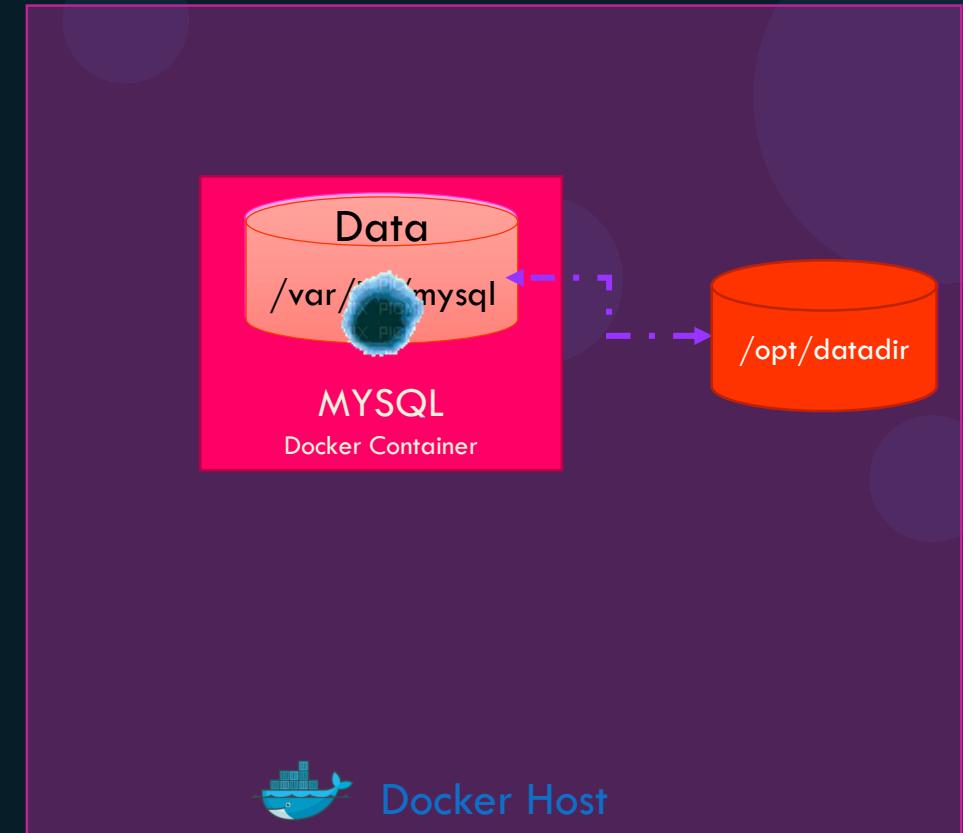
```
root@osboxes:/root # docker run -p 8306:3306 -e MYSQL_ROOT_PASSWORD=pass mysql
docker: Error response from daemon: driver failed programming external connectivity on endpoint boring_bhabha (5079d342b7e8ee11c71d46): Bind for 0.0.0.0:8306 failed: port is already allocated.
```

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)
```

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docker environment variables

Environment Variables

app.py

```
import os
from flask import Flask

app = Flask(__name__)

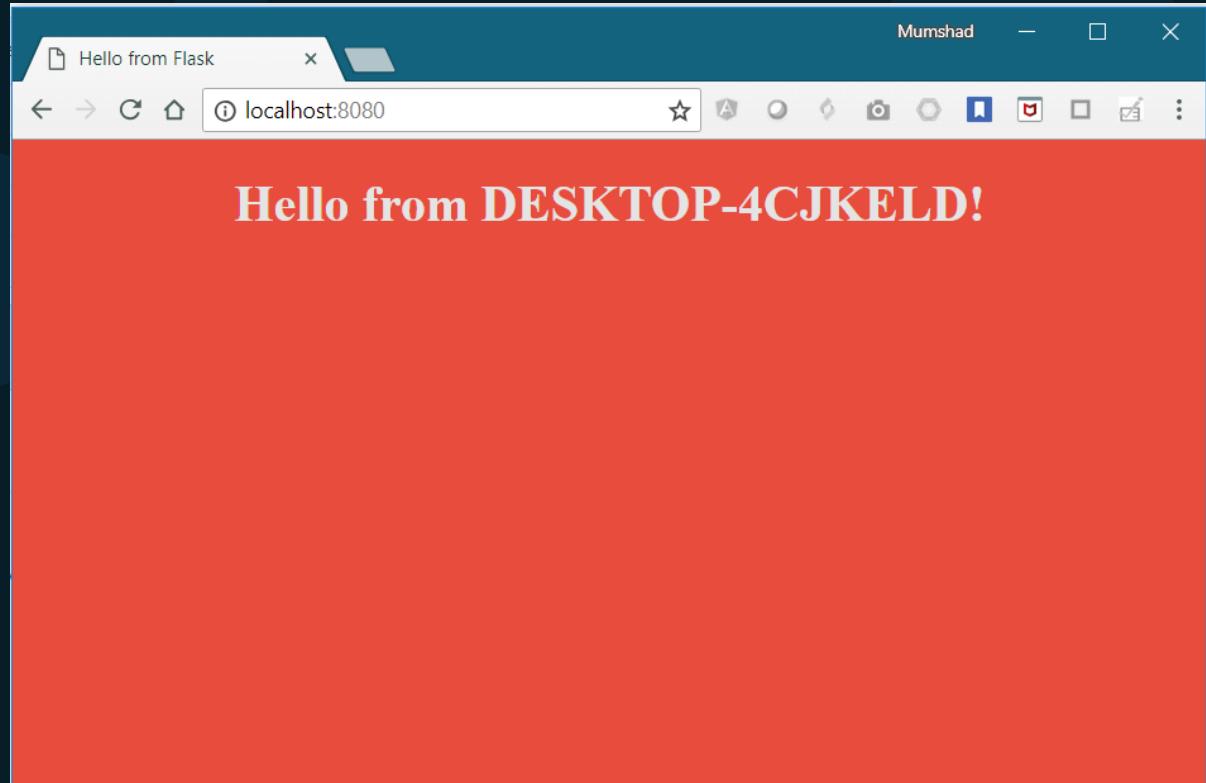
...
...

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

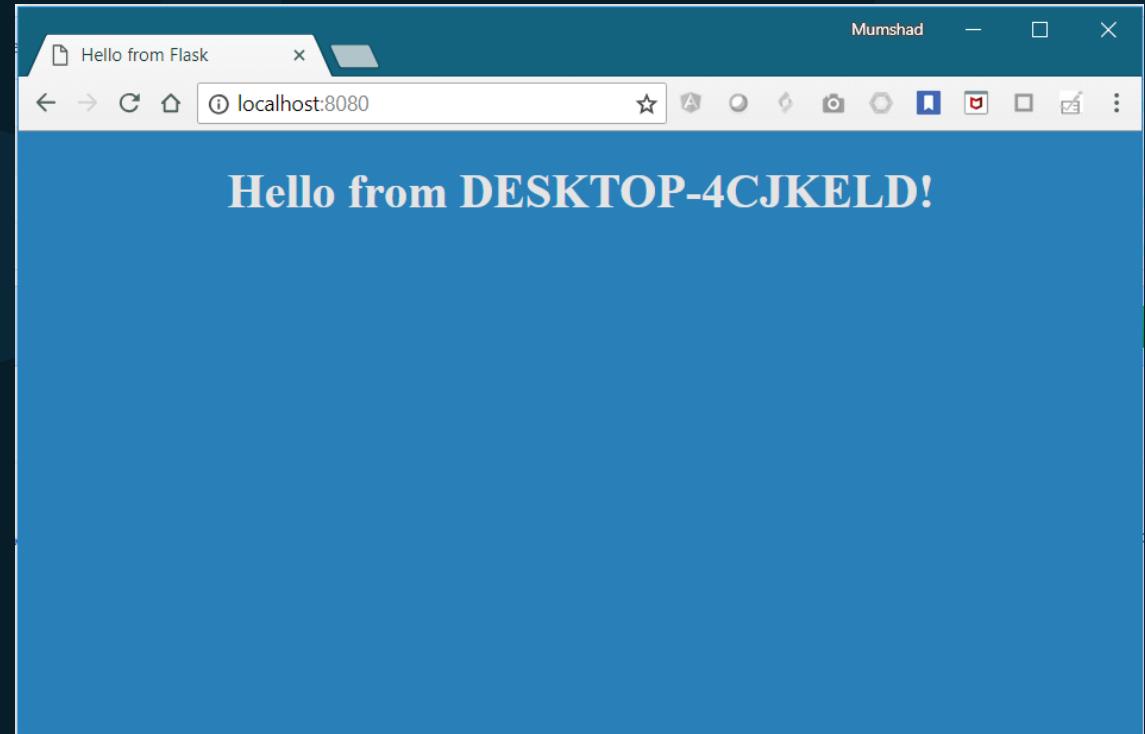
app = Flask(__name__)

...
...

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

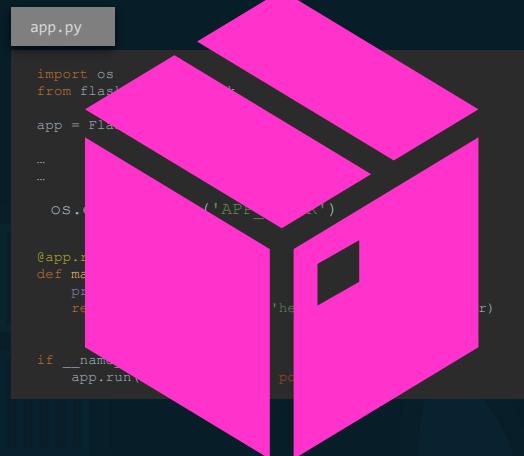
@app.route("/")
def main():
    print(color)
    return render_template('hello.html', color=color)

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

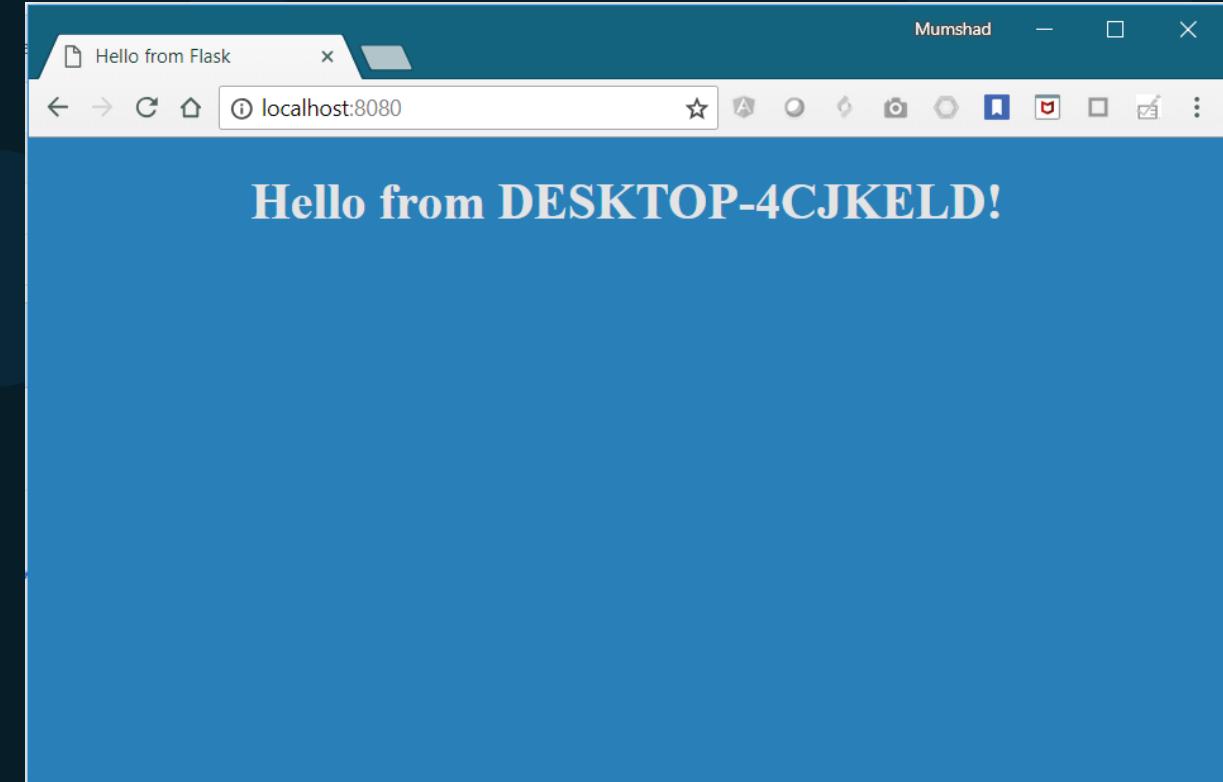
import os
from flask import Flask

app = Flask(__name__)

...
os.environ['APP_COLOR'] = 'blue'

@app.route('/')
def main():
    print(os.environ['APP_COLOR'])
    return 'Hello from DESKTOP-4CJKELD!'

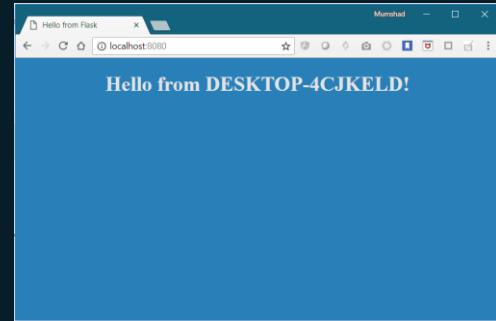
if __name__ == '__main__':
    app.run()
```



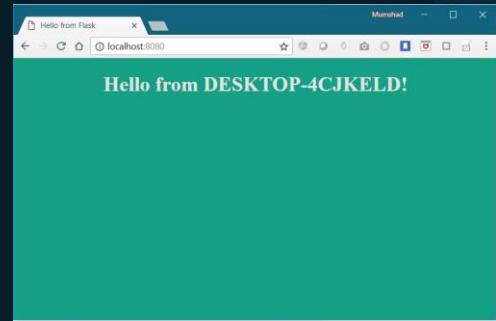
► docker run -e APP_COLOR=blue

ENV Variables in Docker

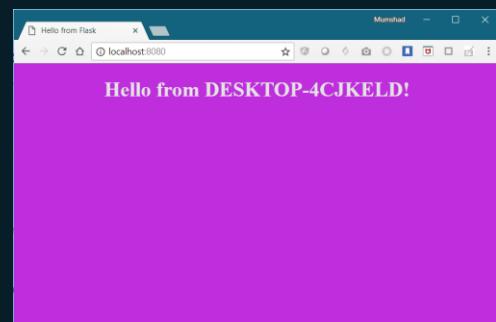
```
▶ docker run -e APP_COLOR=blue simple-webapp-color
```



```
▶ 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"  
      ],  
    }  
  }]
```

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docker images

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

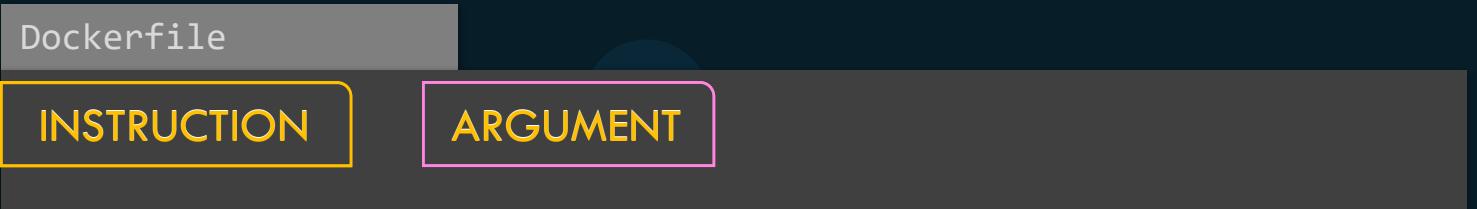
6. Run the web server using “flask” command

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

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

Docker
Registry

Dockerfile



```
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
```

The Dockerfile contains the following instructions:

- FROM Ubuntu**: Start from a base OS or another image.
- RUN apt-get update**: Install all dependencies.
- RUN apt-get install python**: Install all dependencies.
- RUN pip install flask**: Copy source code.
- RUN pip install flask-mysql**: Copy source code.
- COPY . /opt/source-code**: Copy source code.
- ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run**: Specify Entrypoint.

Layered architecture

Dockerfile

```
FROM Ubuntu

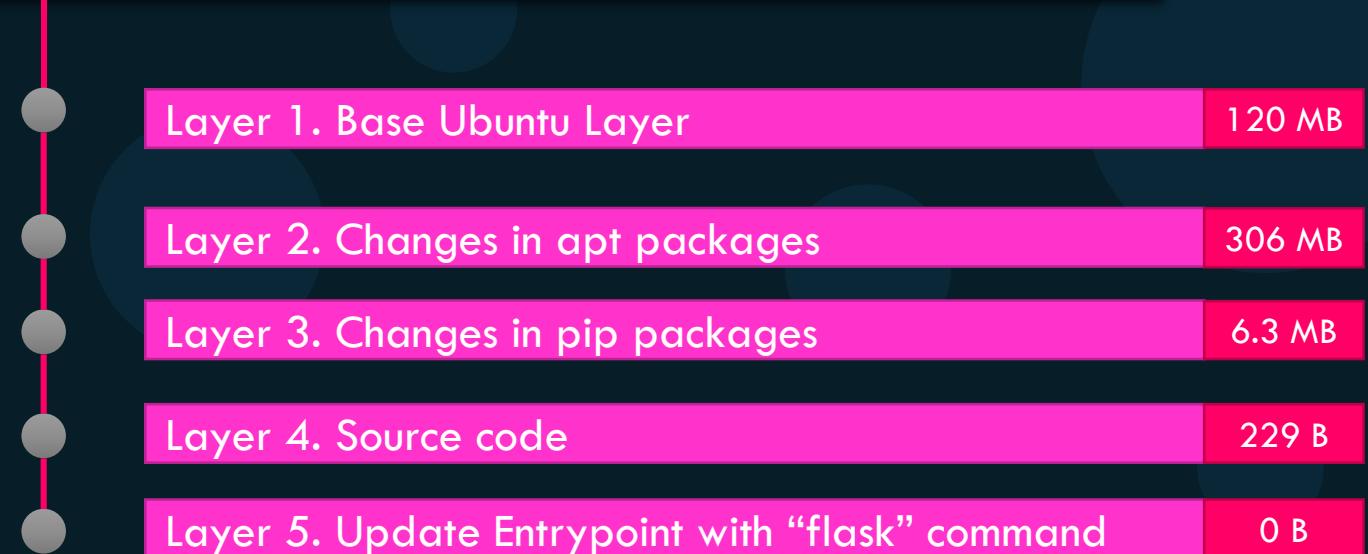
RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY . /opt/source-code

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

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



```
root@osboxes:/root/simple-webapp-docker # docker history : 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 imon/my-custom-app
```

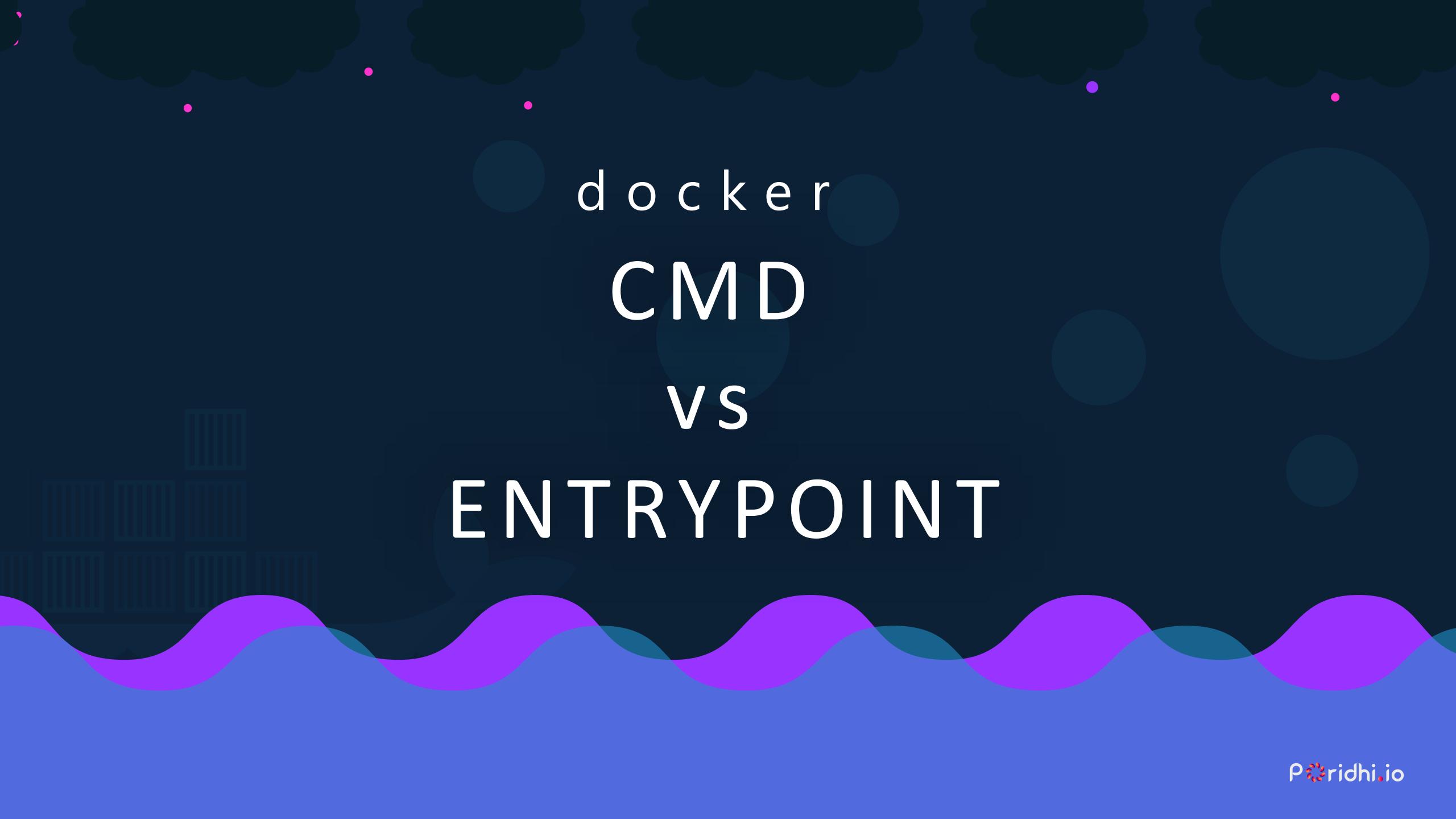
```
root@osboxes:/root/simple-webapp-docker # docker build .
Sending build context to Docker daemon 5.12kB
Step 1/5 : FROM ubuntu
--> ccc7a11d65b1
Step 2/5 : RUN apt-get update && apt-get install -y python python-pip
--> Using cache
--> e4c055538e60
Step 3/5 : RUN pip install flask
--> Running in aacdaccd7403
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!!!

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docker CMD vs ENTRYPOINT

```
▶ docker run ubuntu
```

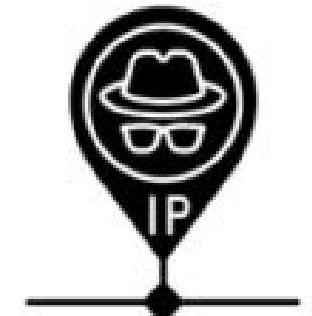
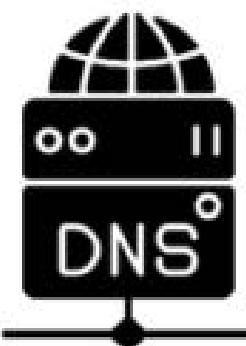
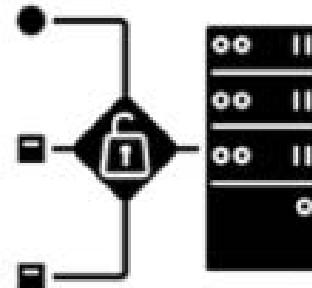
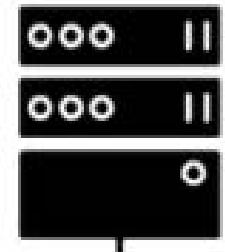
```
▶ docker ps
```

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	

Traditional Security Control



Potentially blind to a container workloads.



```
# 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  
  
    command.  
  
# Define default  
CMD ["nginx"]
```

```
ARG MYSQL_SERVER_PACKAGE_URL=https://repo.mysql.com/yum/mysql-8.0-community/docker/x86_64/rpm/mysql-community-release-el7-1.noarch.rpm  
ARG MYSQL_SHELL_PACKAGE_URL=https://repo.mysql.com/yum/mysql-tools-community/el/7/x86_64/rpm/mysql-tools-community-release-el7-1.noarch.rpm  
  
# 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  
# Pull base image.  
# 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

```
FROM Ubuntu
```

```
sleep
```

```
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 sleep2.0 ubuntu-sleeper 10
```

Command at Startup:

	No ENTRYPOINT	ENTRYPOINT exec_entry p1_entry	ENTRYPOINT ["exec_entry", "p1_entry"]
No CMD	<i>error, not allowed</i>	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry
CMD ["exec_cmd", "p1_cmd"]	exec_cmd p1_cmd	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry exec_cmd p1_cmd
CMD ["p1_cmd", "p2_cmd"]	p1_cmd p2_cmd	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry p1_cmd p2_cmd
CMD exec_cmd p1_cmd	/bin/sh -c exec_cmd p1_cmd	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry /bin/sh -c exec_cmd p1_cmd



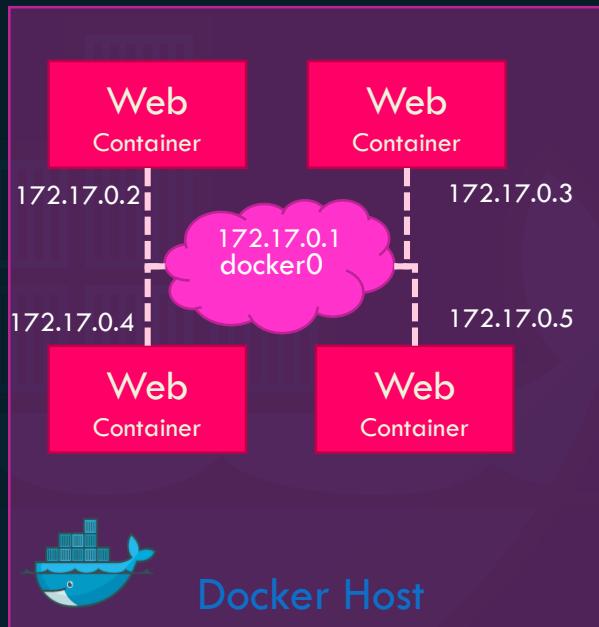


d o c k e r networking

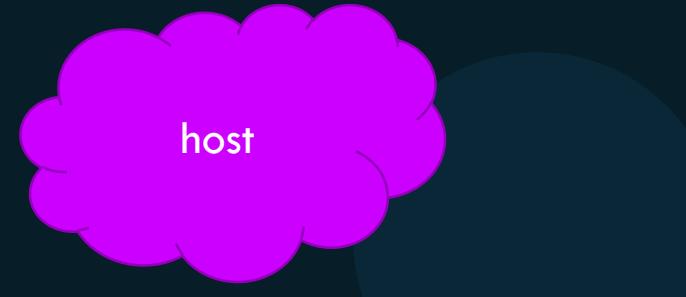
Default networks



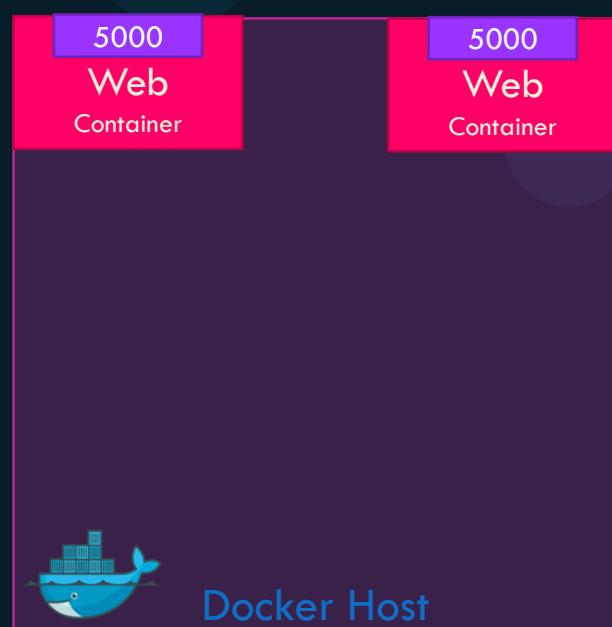
```
docker run ubuntu
```



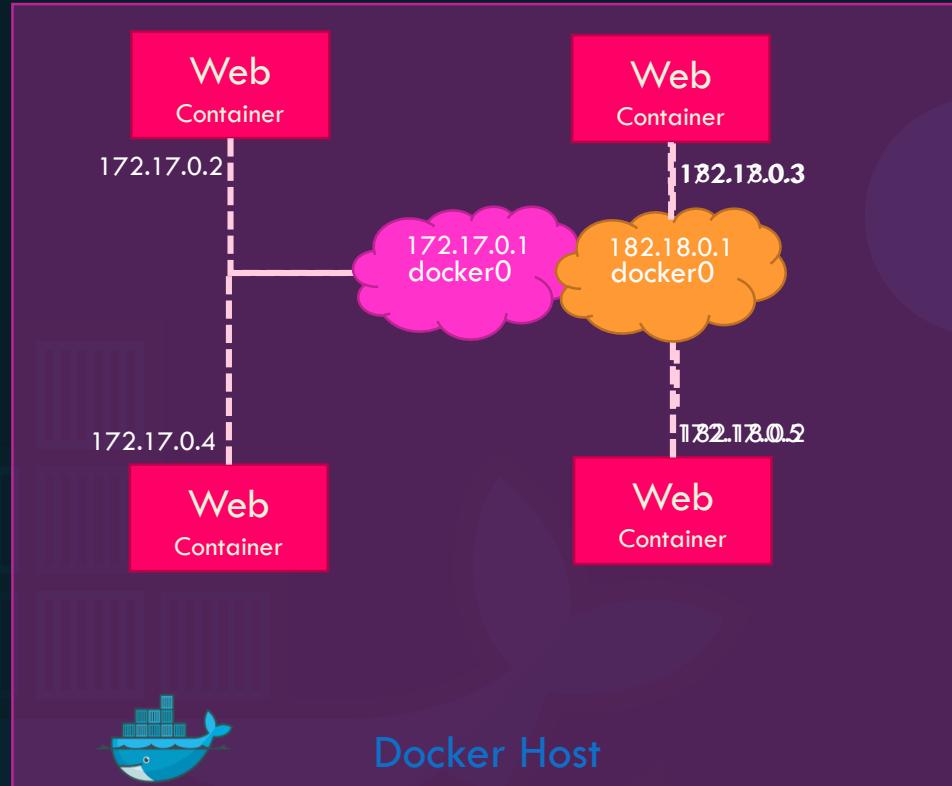
```
docker run Ubuntu --network=none
```



```
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
```

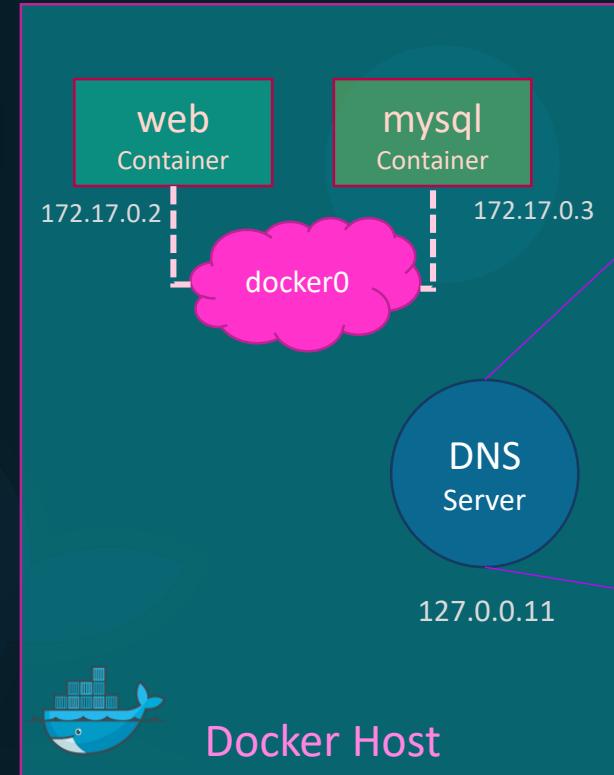
NETWORK ID	NAME	DRIVER	SCOPE
dba0fb9370fe	bridge	bridge	local
46d476b87cd9	customer-isolated-network	bridge	local
6de685cec1ce	docker_gwbridge	bridge	local
e29d188b4e47	host	host	local
mmrho7vsb9rm	ingress	overlay	swarm
d9f11695f0d6	none	null	local
d371b4009142	simplewebappdocker_default	bridge	local

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

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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 imon/my-custom-app
```

Dockerfile2

```
FROM Ubuntu

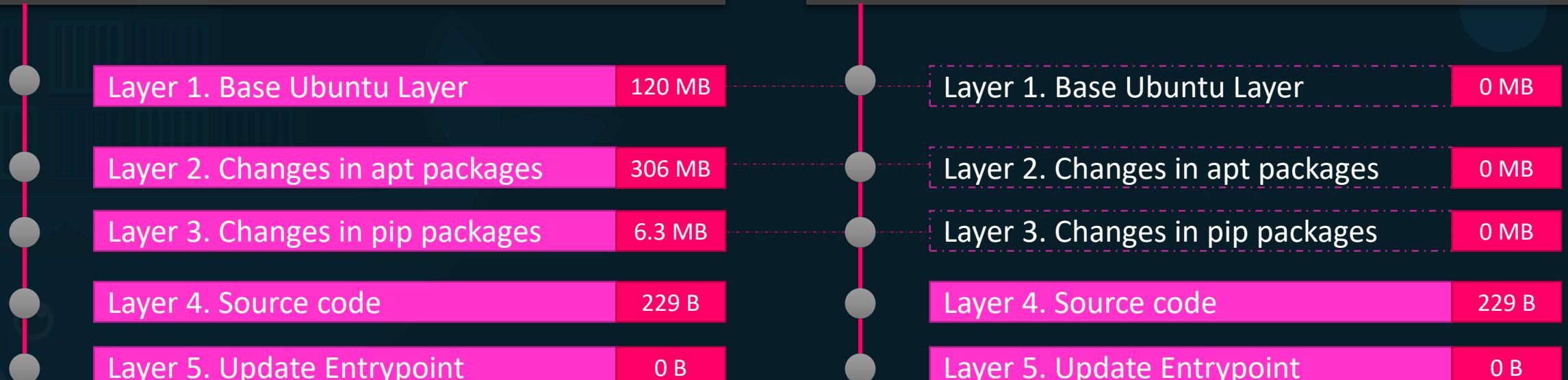
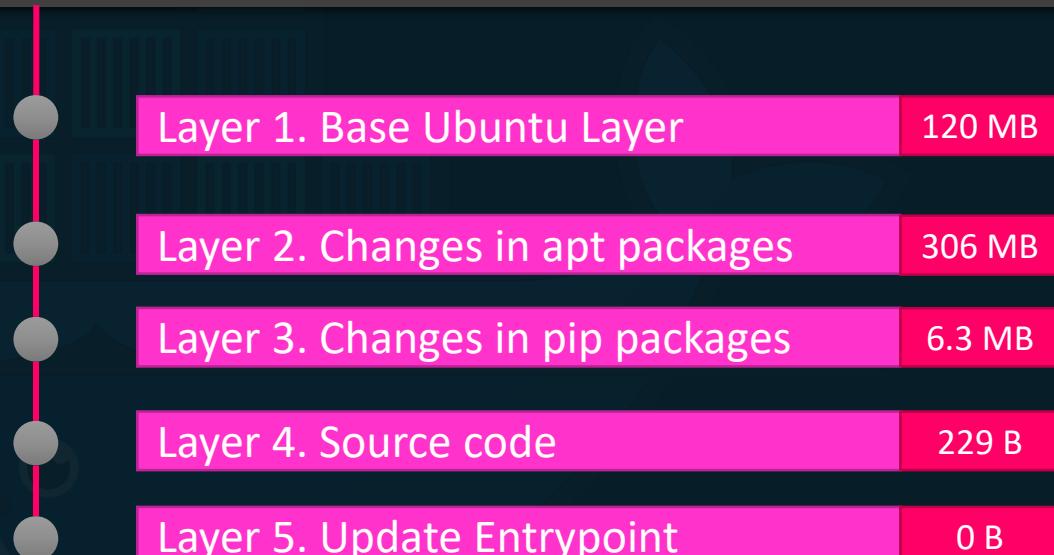
RUN apt-get update && apt-get -y install python

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 imon/my-custom-app-2
```



Layered architecture

Container Layer

Read Write

Layer 6. Container Layer

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

Image Layers

Read Only

Layer 5. Update Entrypoint with “flask” command

Layer 4. Source code

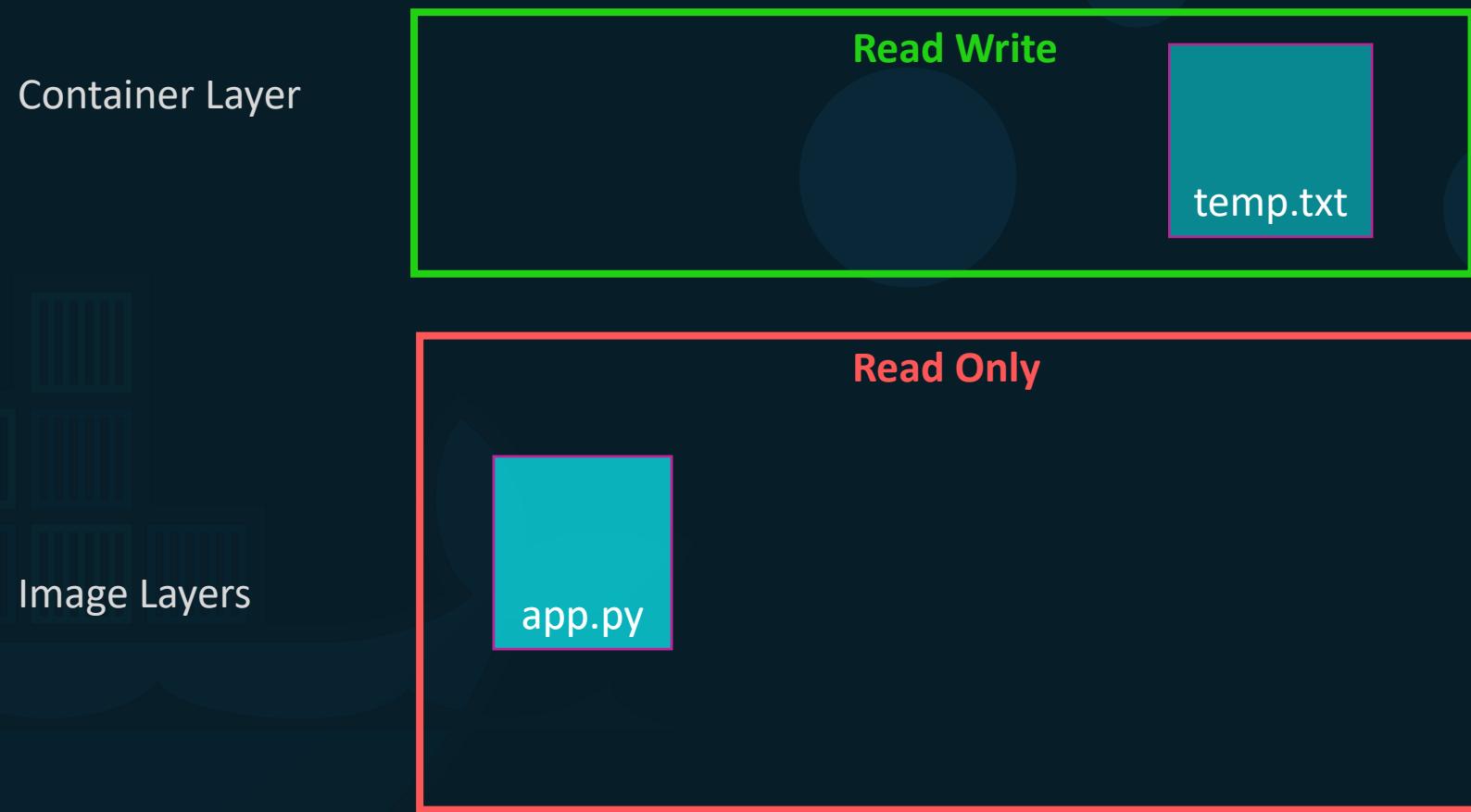
Layer 3. Changes in pip packages

Layer 2. Changes in apt packages

Layer 1. Base Ubuntu Layer

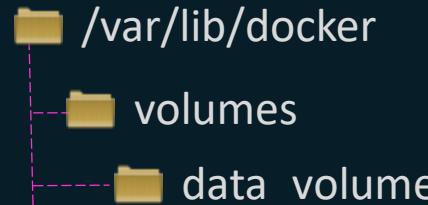
```
docker build Dockerfile -t imon/my-custom-app
```

COPY-ON-WRITE



volumes

```
docker volume create data_volume
```

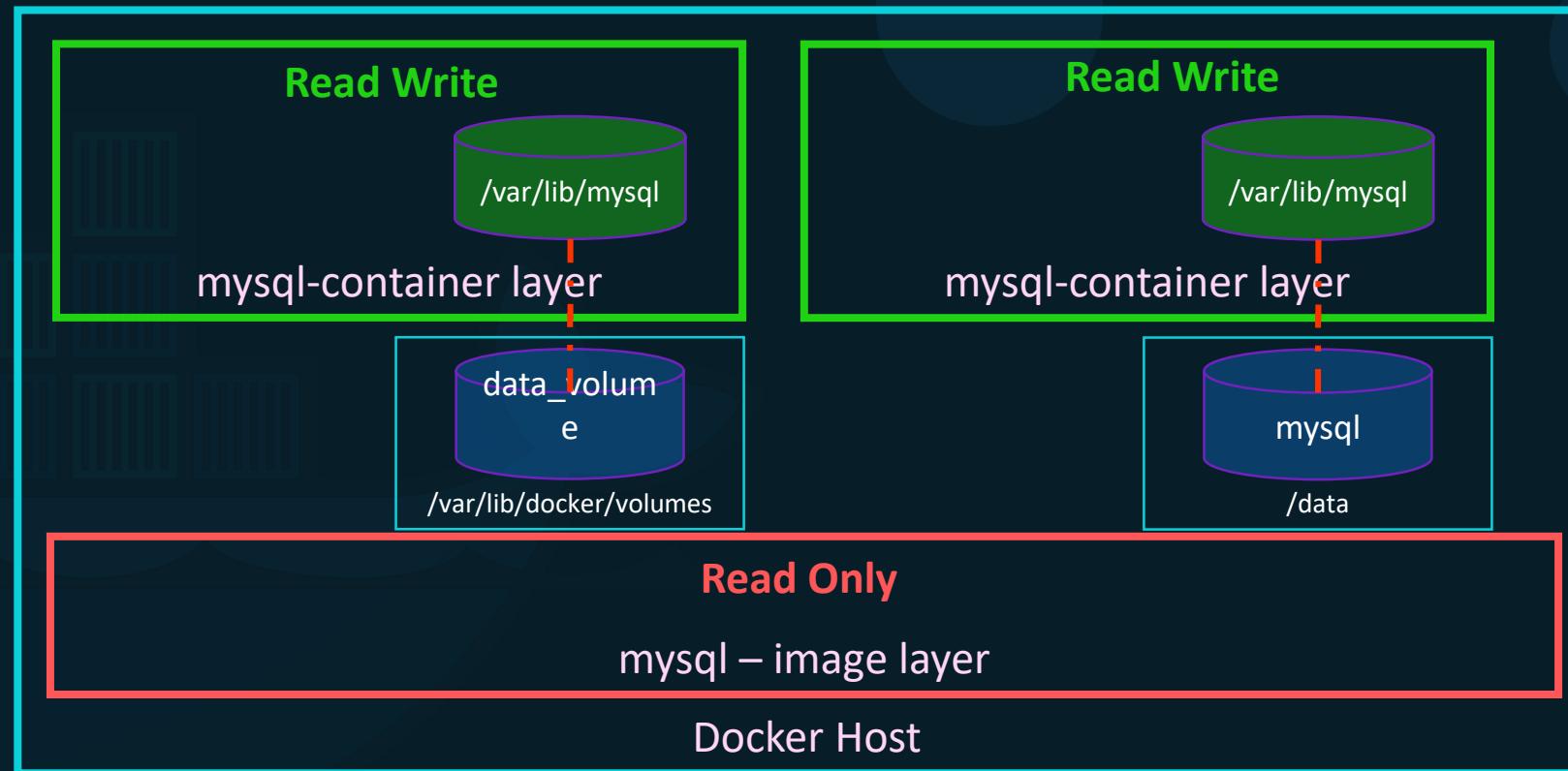


```
docker run -v data_volume:/var/lib/mysql mysql
```

```
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

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d o c k e r
compose

Docker compose

```
docker run imon/simple-webapp
```

```
docker run mongodb
```

```
docker run redis:alpine
```

```
docker run ansible
```

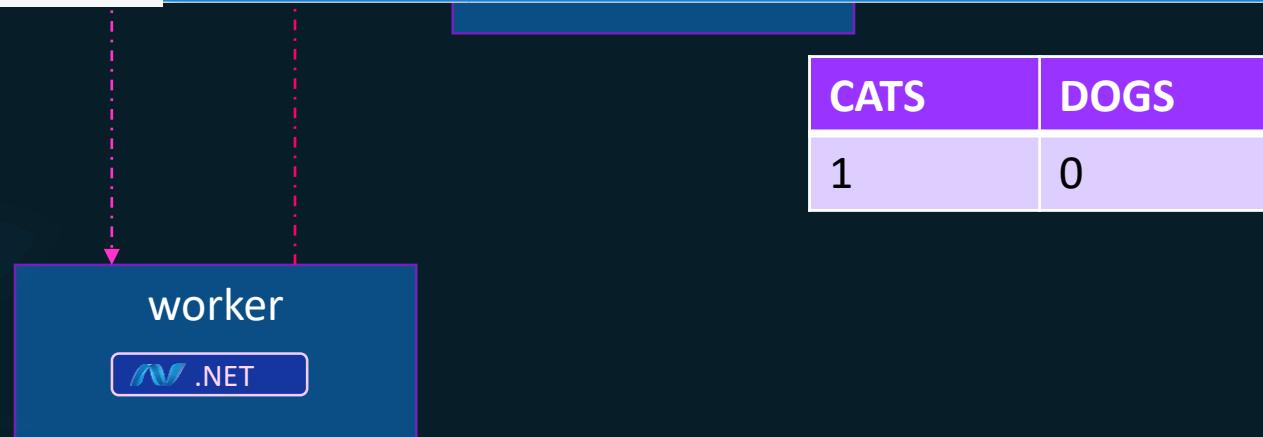
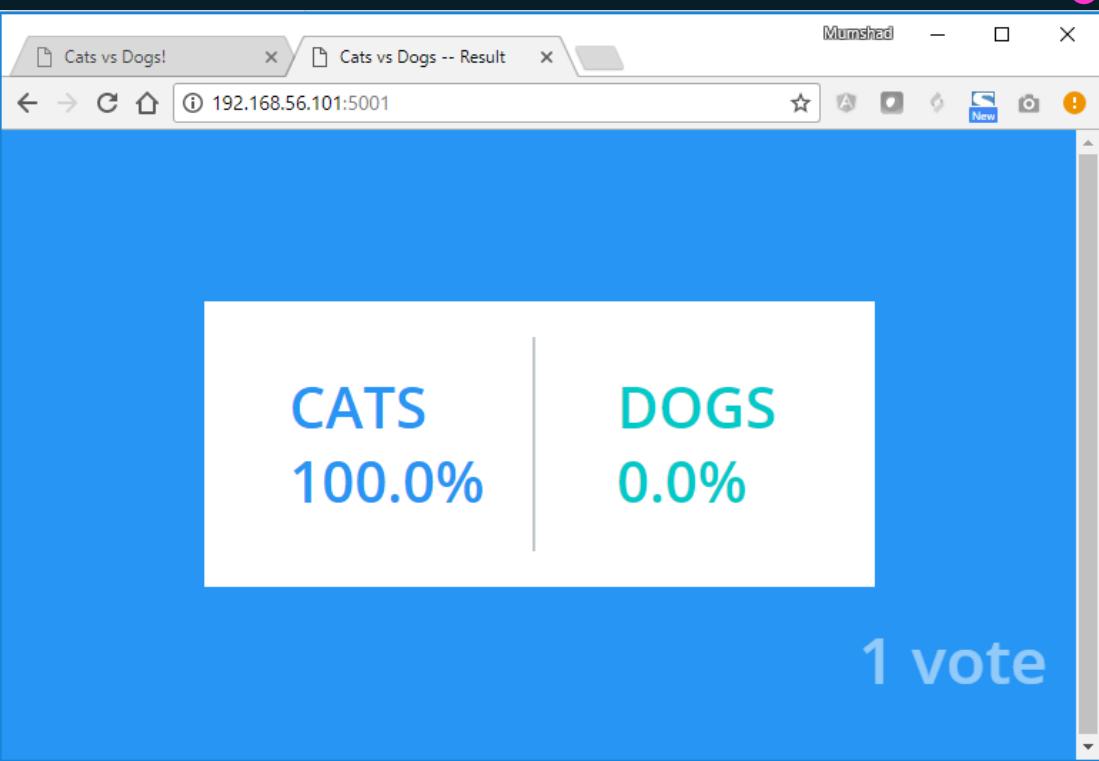
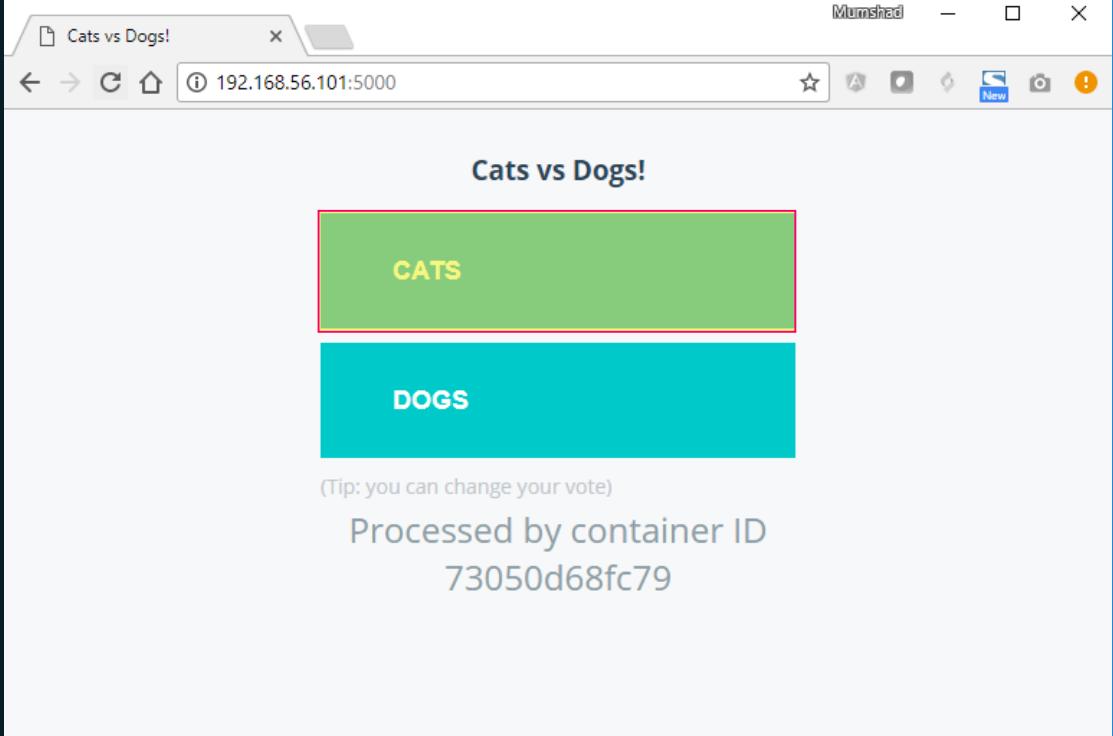
docker-compose.yml

```
services:  
  web:  
    image: "imon/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
```

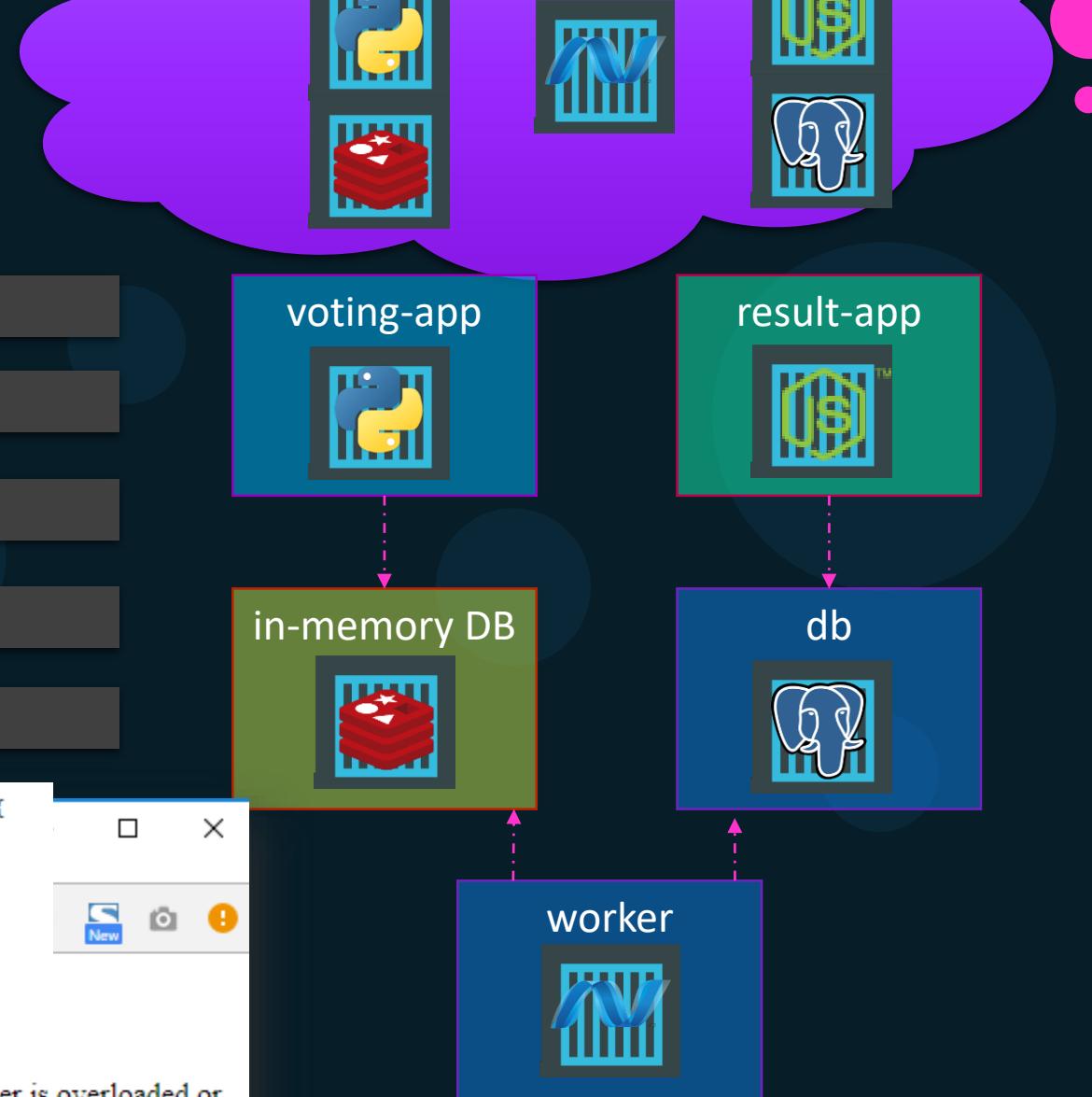
```
docker run -d --name=worker --link db:db --link redis:redis
```

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

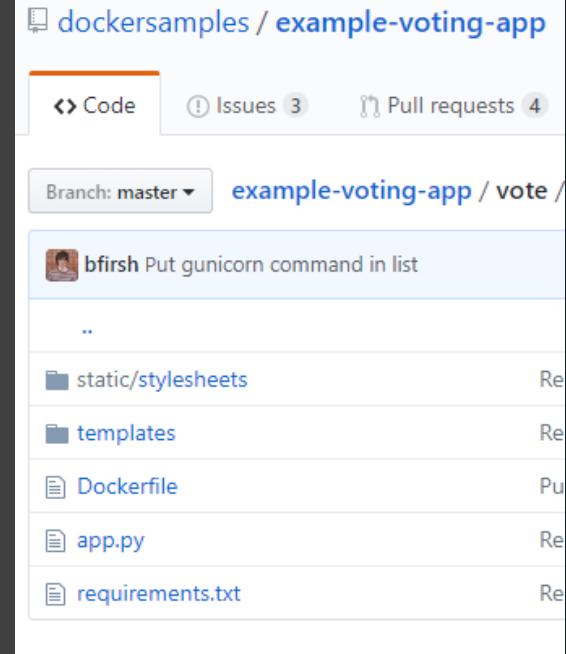
Docker compose - build

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

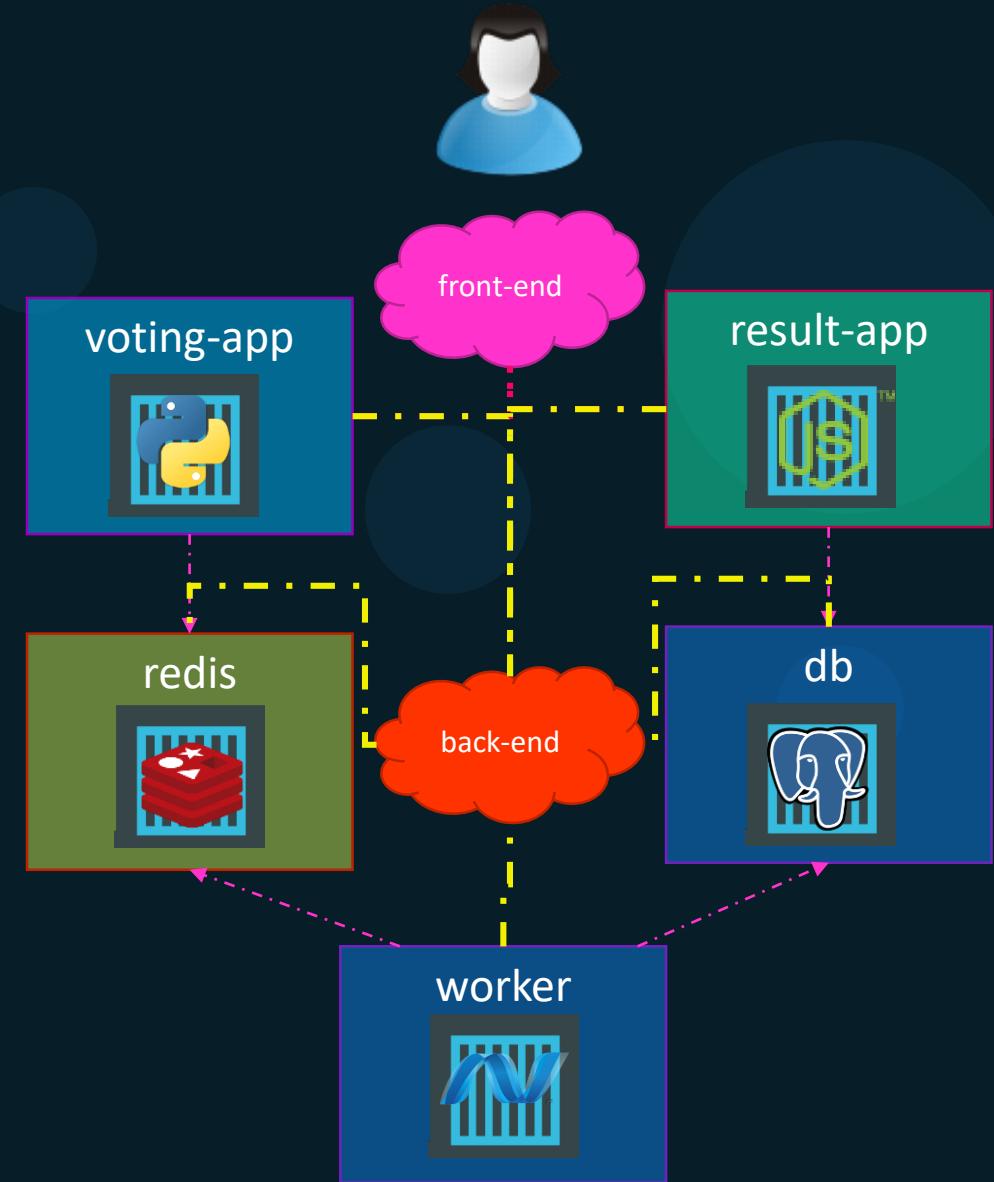
```
version: 3  
services:
```

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:
```



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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
```

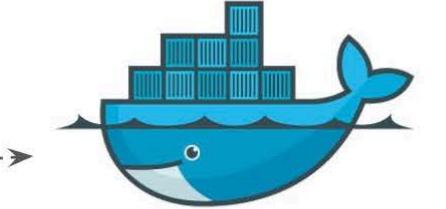
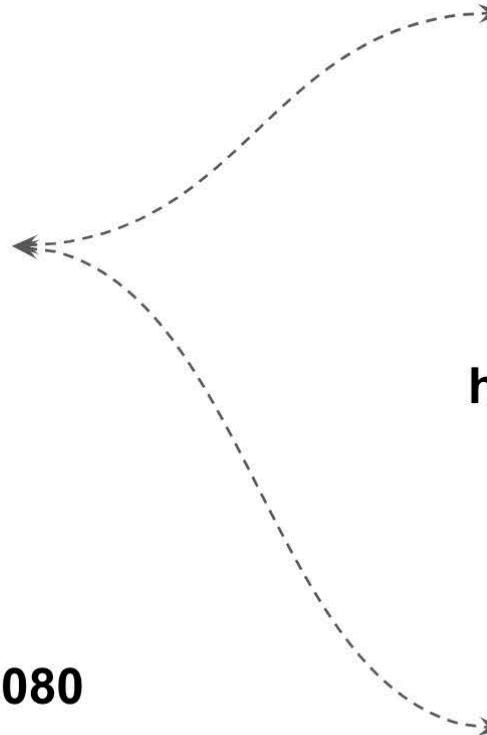
```
▶ docker push localhost:5000/my-image
```

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

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



<http://localhost:8080>



<http://localhost:8192>

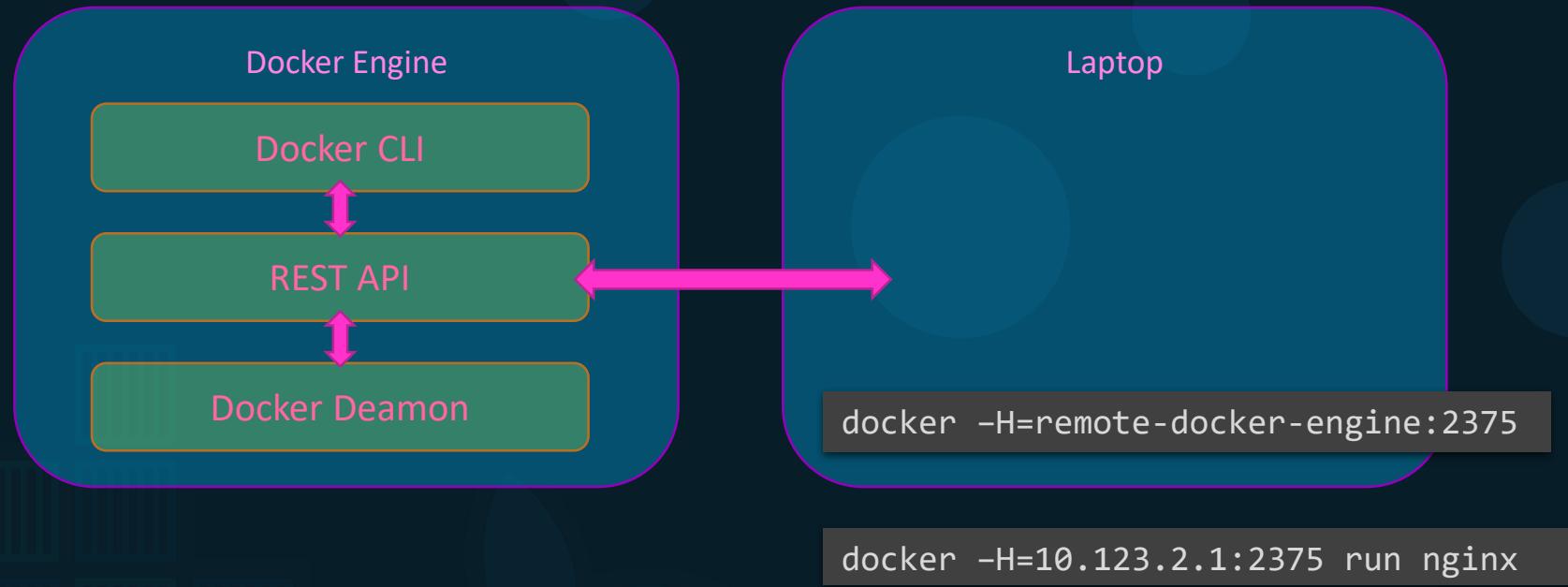


<http://localhost:8191>

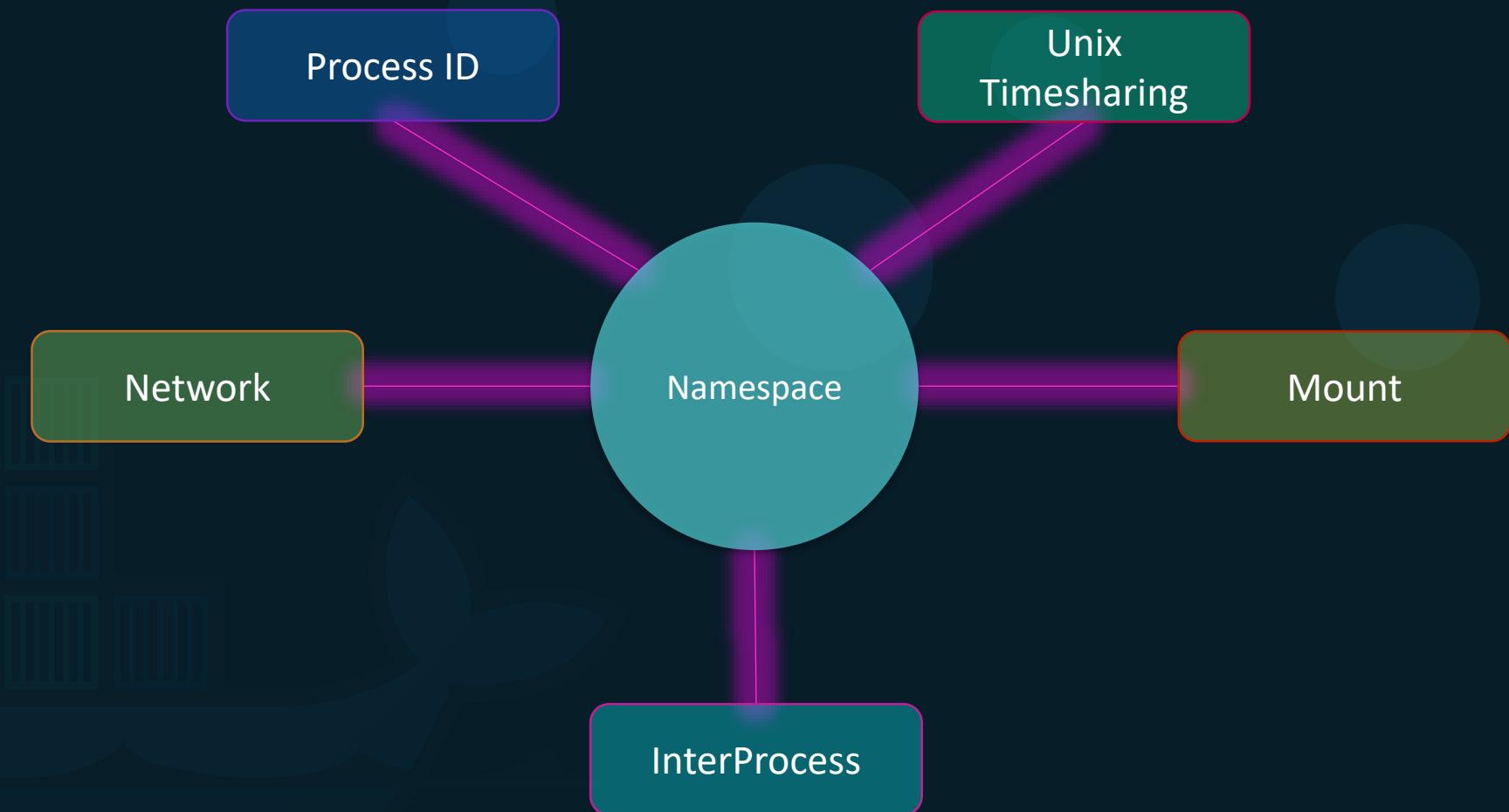


docker engine

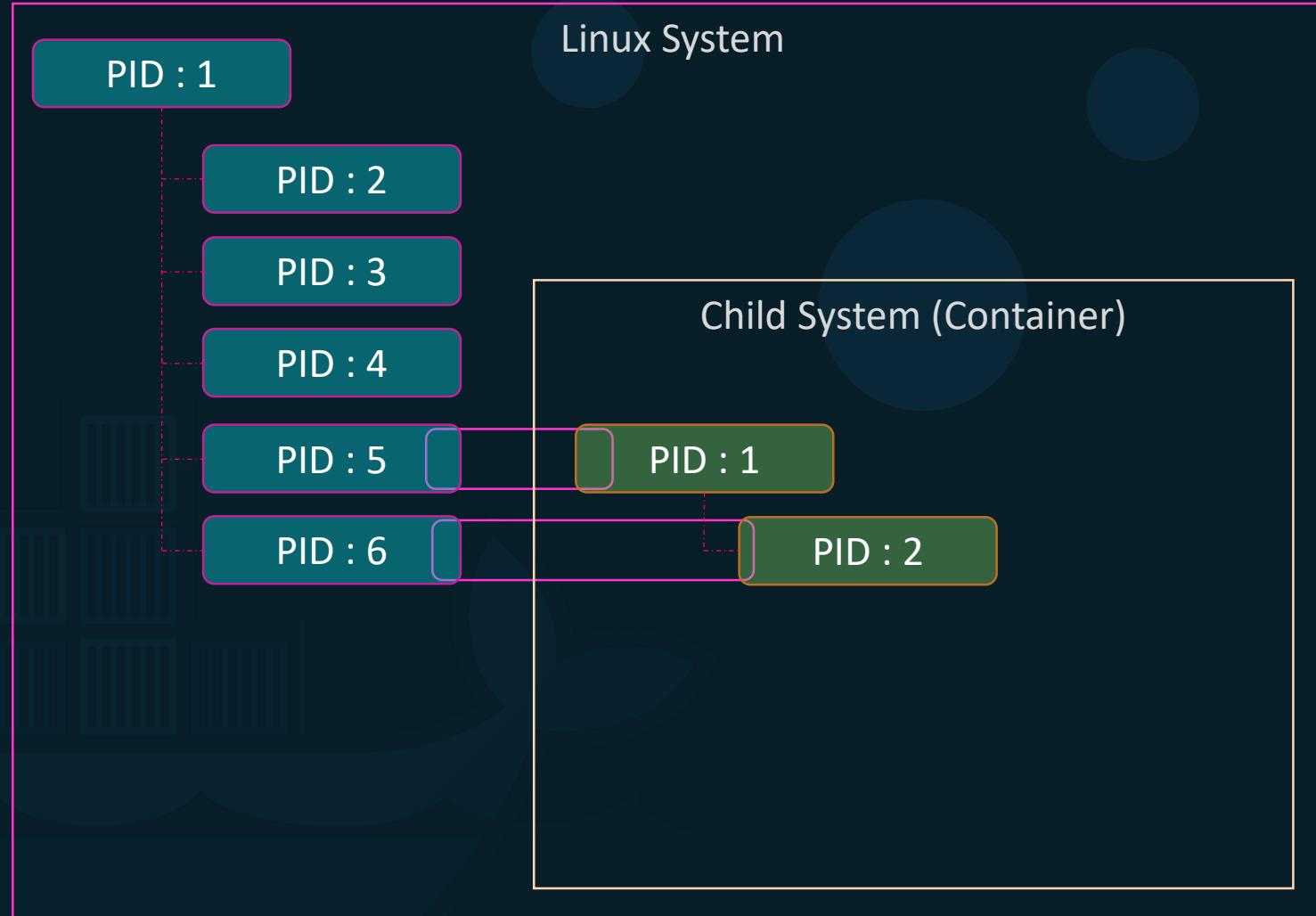
Docker Engine



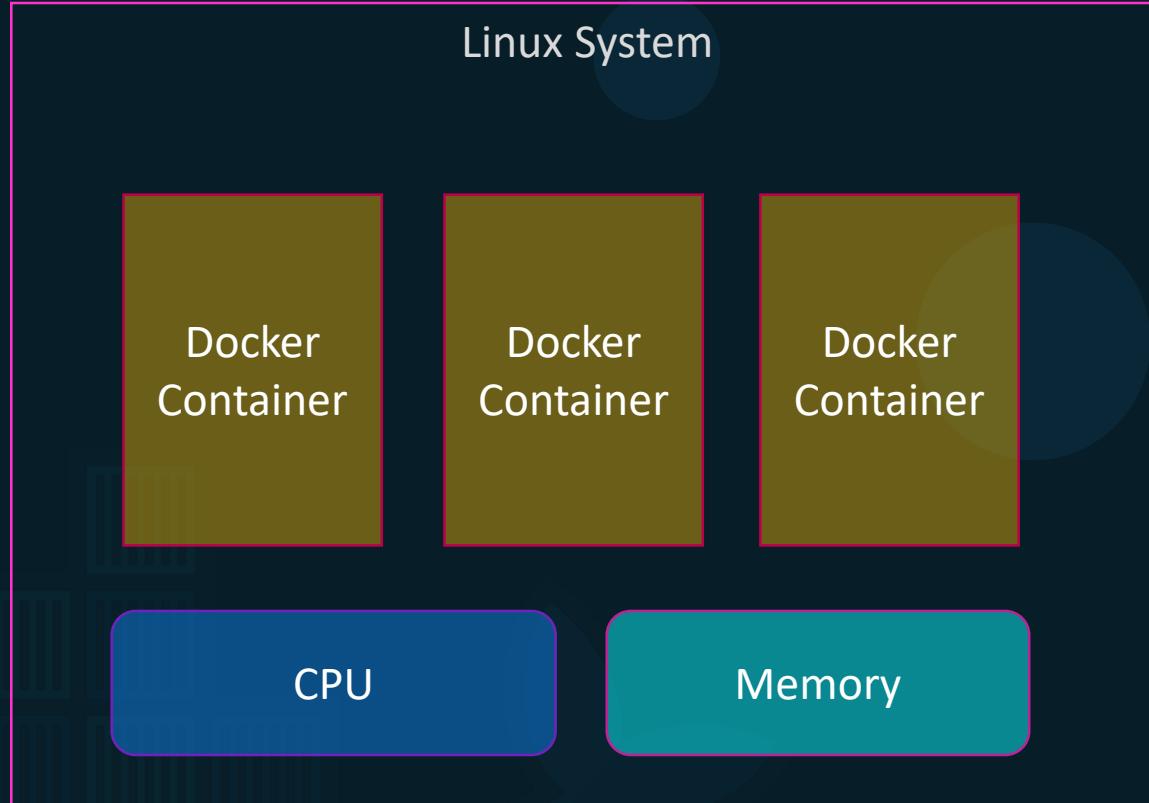
containerization



Namespace - PID



cgroups



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

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

Paridhi.io

The logo for Paridhi.io features the word "Paridhi" in a large, bold, blue sans-serif font. To the left of the letter "P", there is a cluster of six abstract, rounded, orange-red shapes of varying sizes, resembling stylized leaves or petals. To the right of "Paridhi", the ".io" suffix is written in a smaller, blue, lowercase sans-serif font.



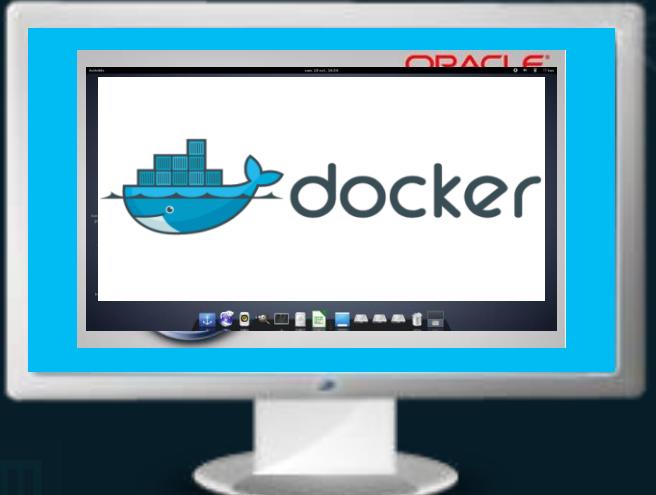
d o c k e r

On Windows

Docker on windows

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

1. Docker toolbox

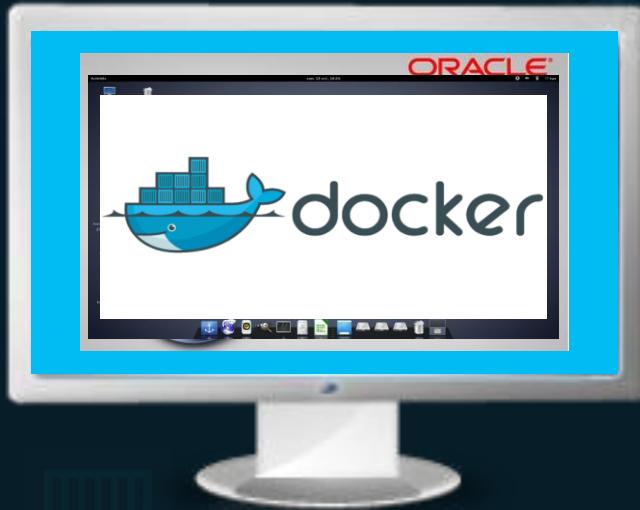


- 64-bit operating
- Windows 7 or higher.
- Virtualization is enabled



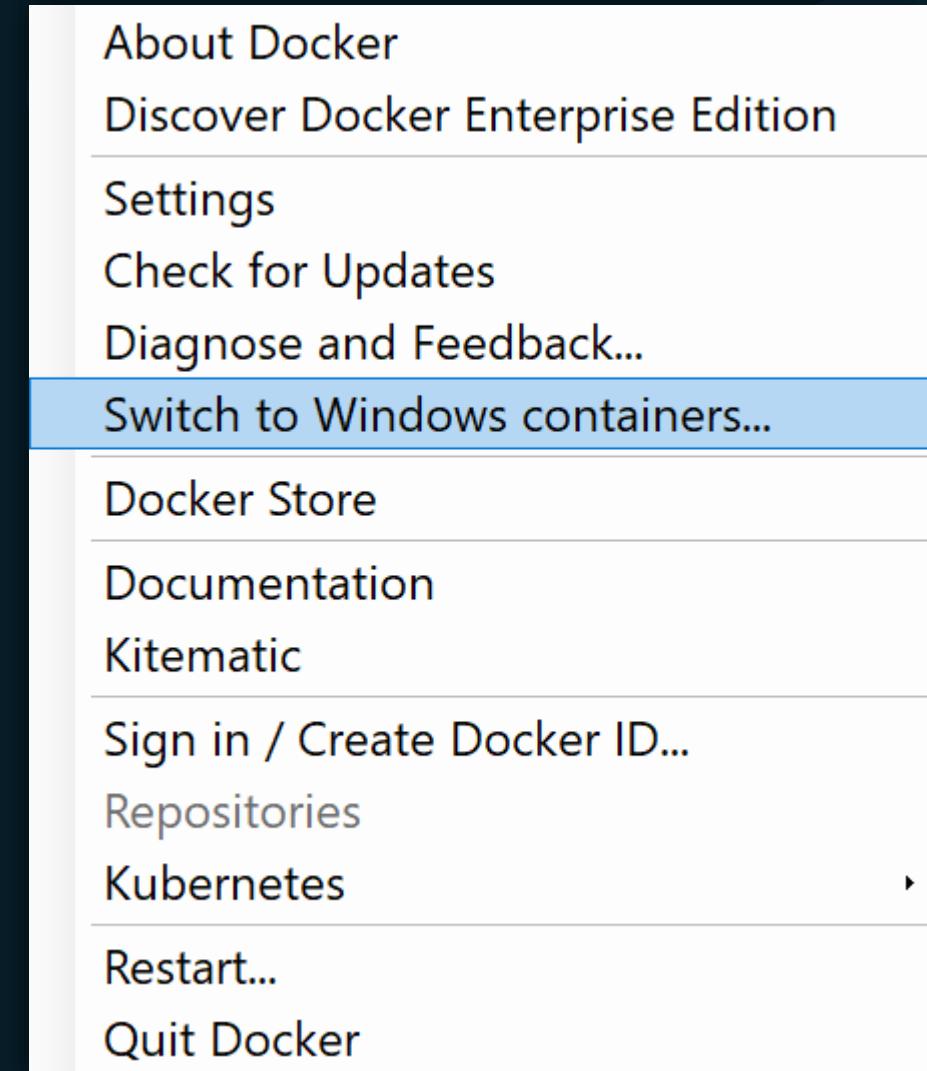
- Oracle Virtualbox
- Docker Engine
- Docker Machine
- Docker Compose
- Kitematic GUI

2. Docker Desktop for Windows



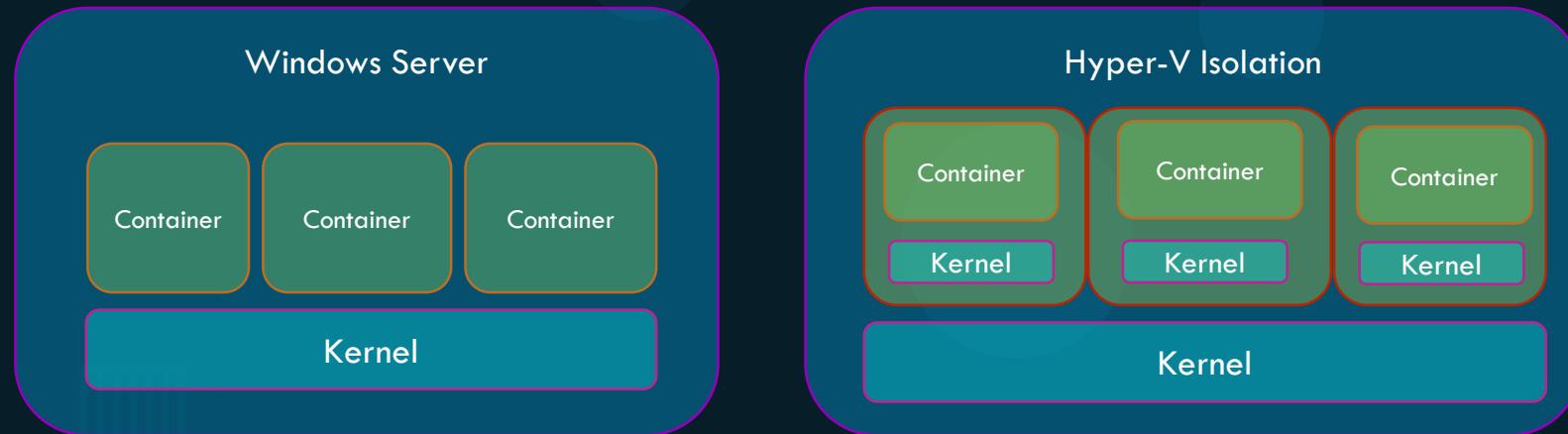
Support: Windows 10 Enterprise/Professional Edition
Windows Server 2016

Linux Containers (Default)
Or
Windows Containers



Windows containers

Container Types:



Base Images:

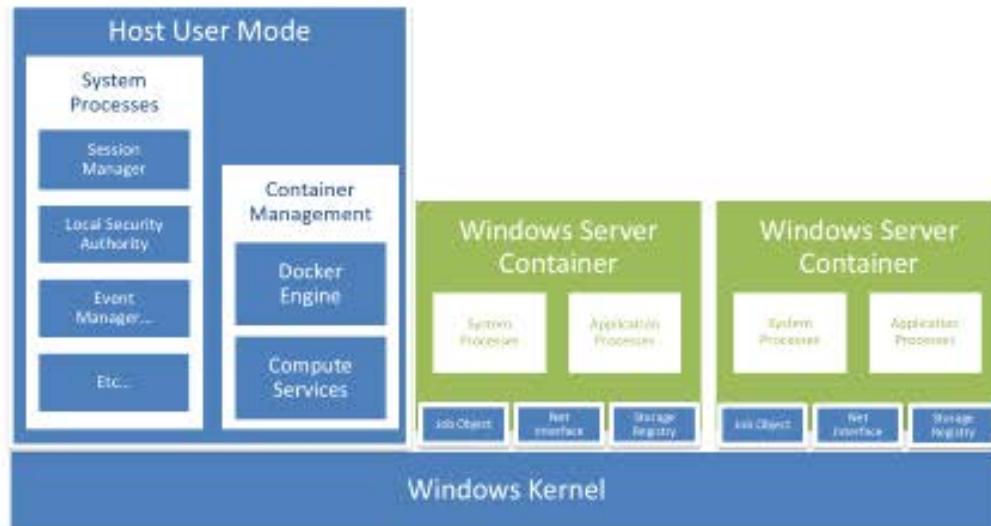
- Windows Server Core
- Nano Server

Support

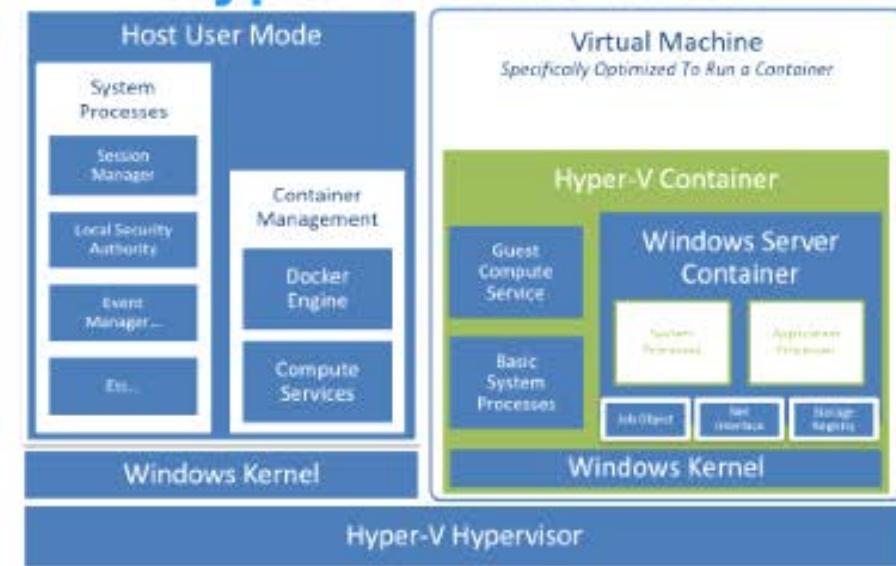
- Windows Server 2016
- Nano Server
- Windows 10 Professional and Enterprise (Hyper-V Isolated Containers)

VirtualBox Or Hyper-V

Windows Server Containers



Hyper-V Containers



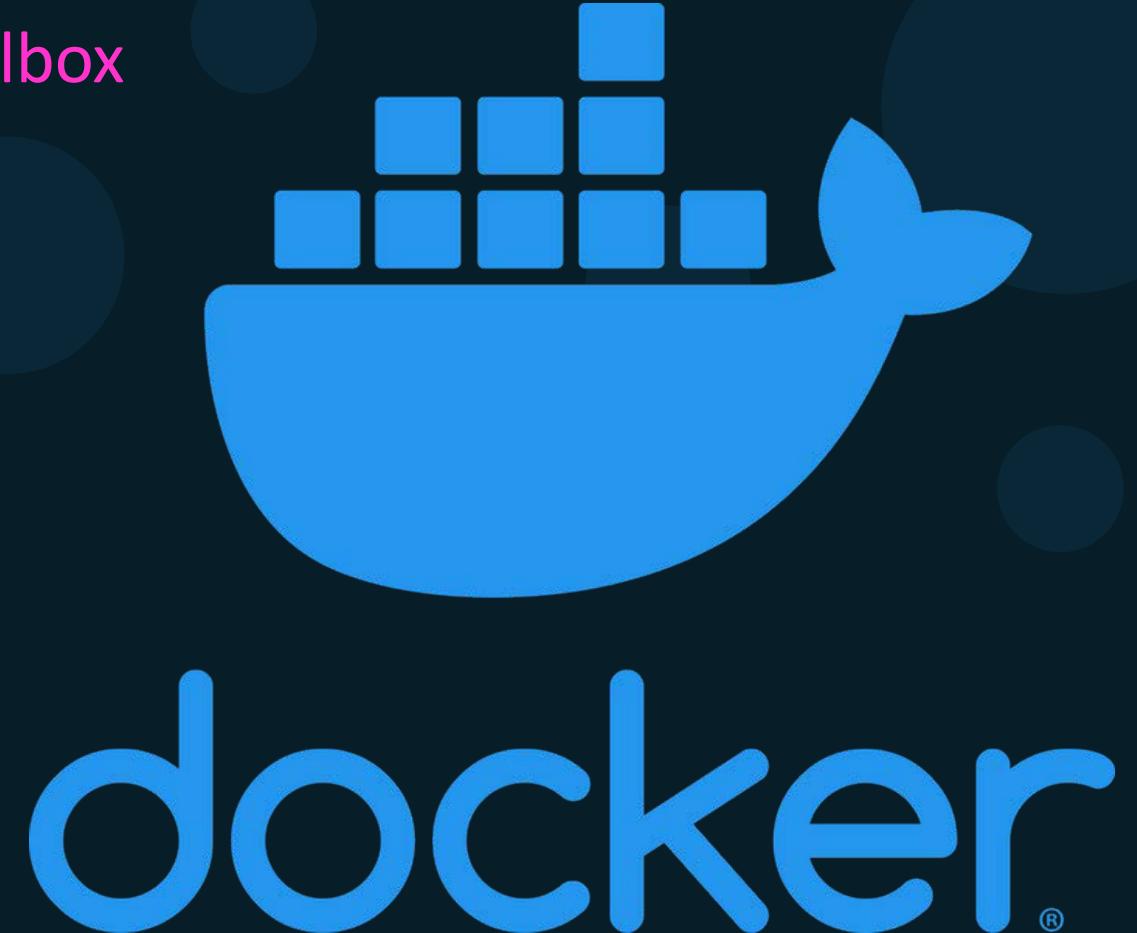
peridhi.io



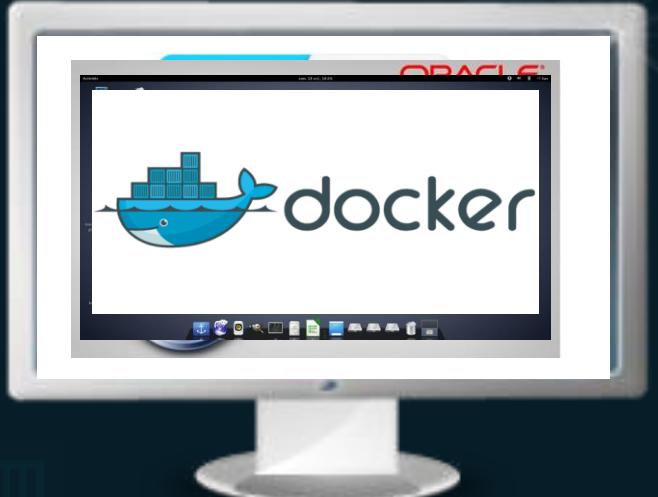
d o c k e r On Mac

Docker on Mac

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



1. Docker toolbox

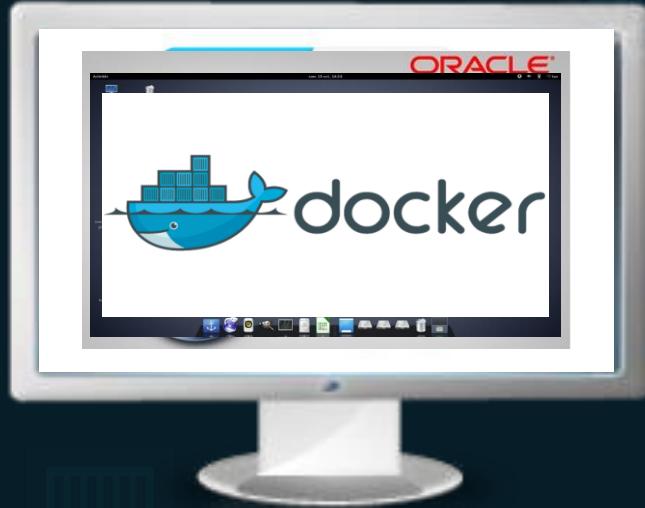


- macOS 10.8 “Mountain Lion” or newer



- 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

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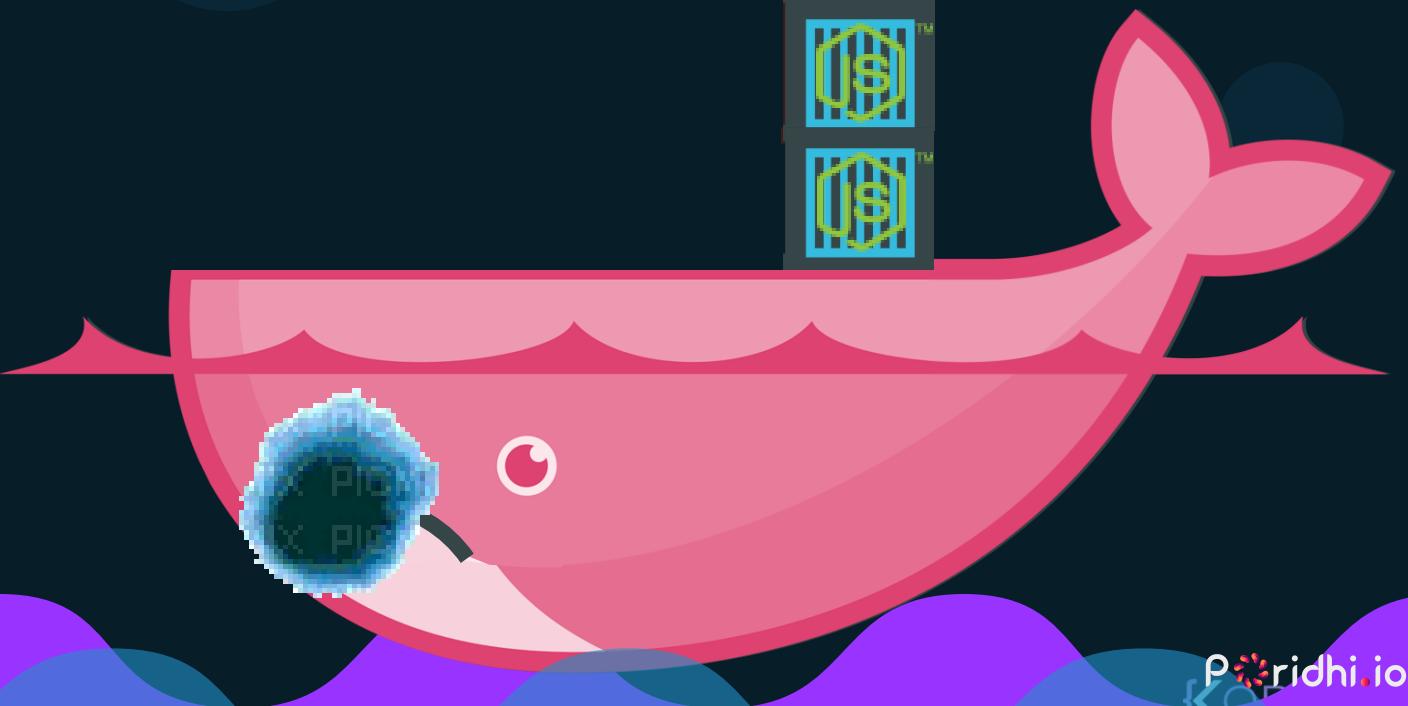
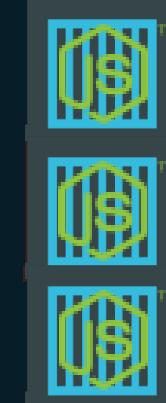
container orchestration

Why Orchestrate?



Public Docker registry - dockerhub

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



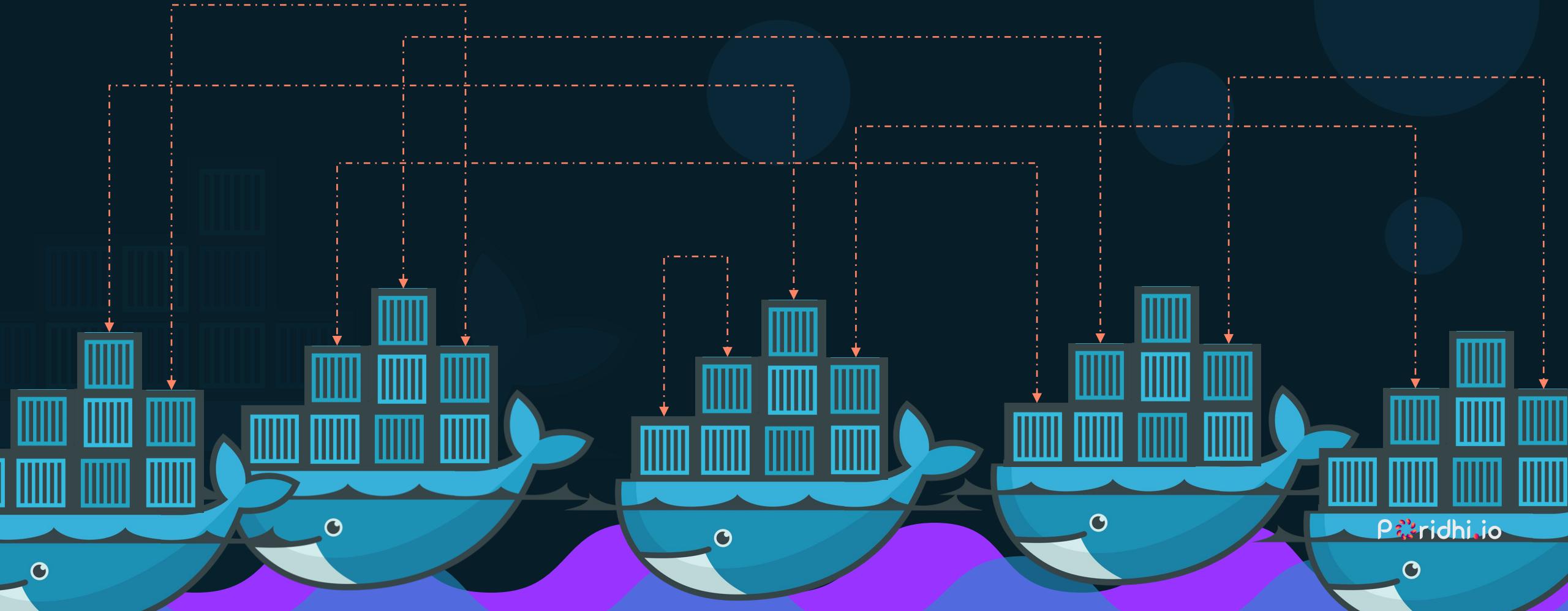
Container Orchestration

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



Container Orchestration

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



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d o c k e r s w a r m

Solutions



Docker Swarm

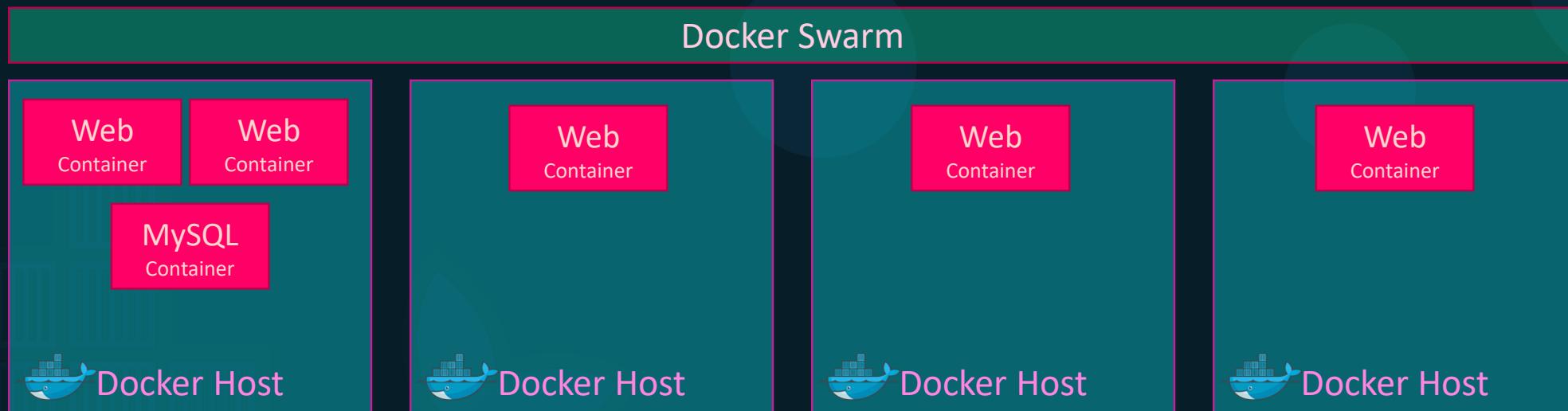


kubernetes



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.
```

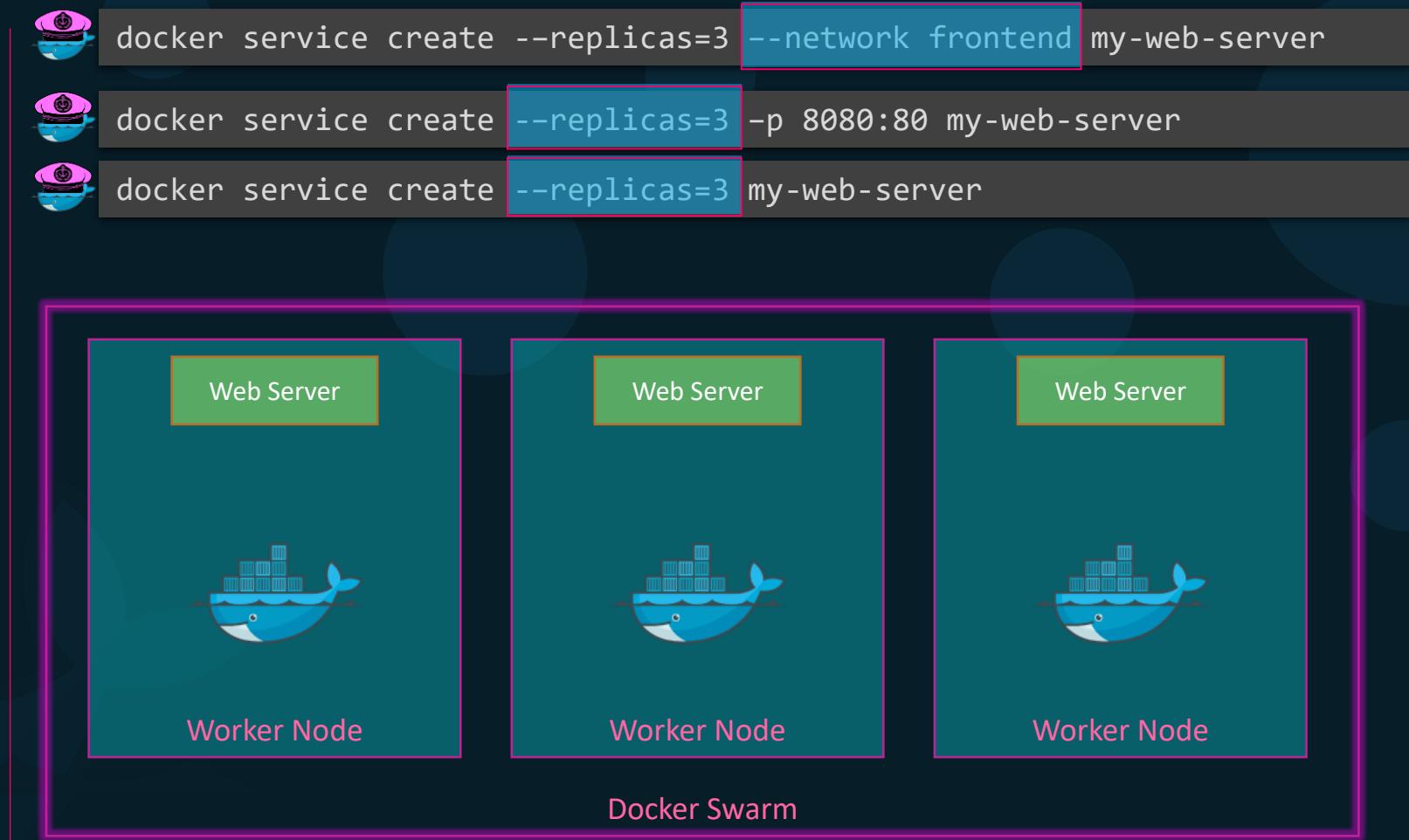
To add a worker to this swarm, run the following command:

```
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

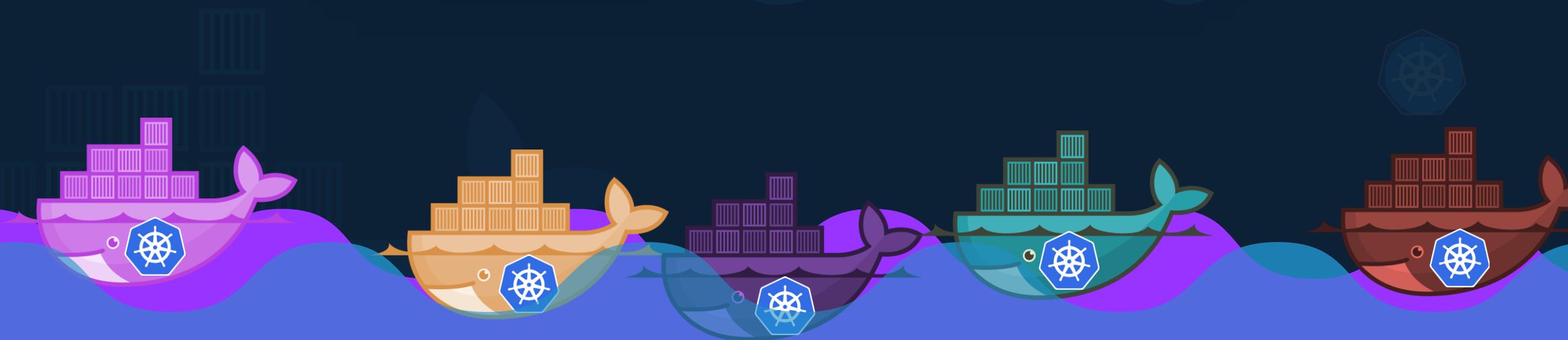
```
docker run my-web-server
```

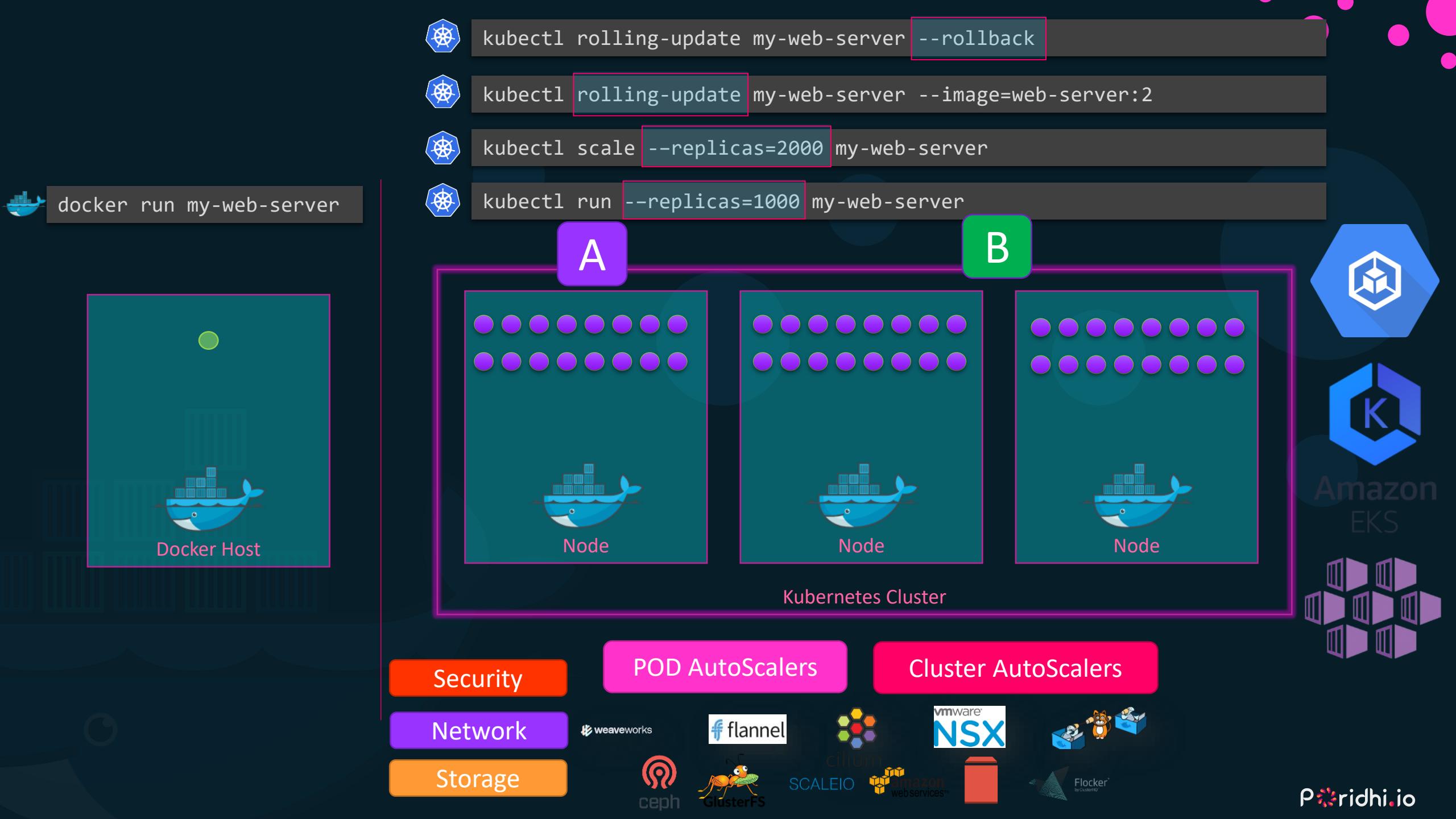


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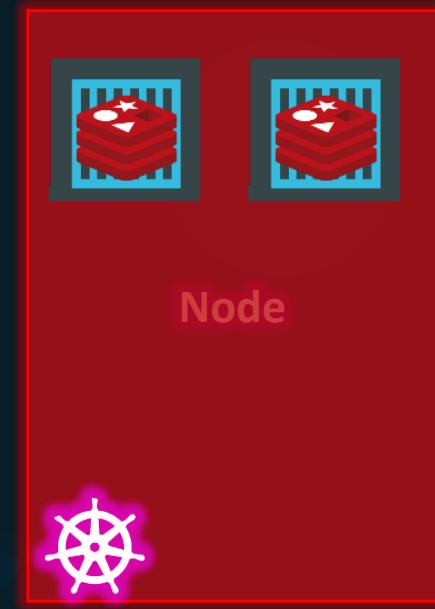


kubernetes

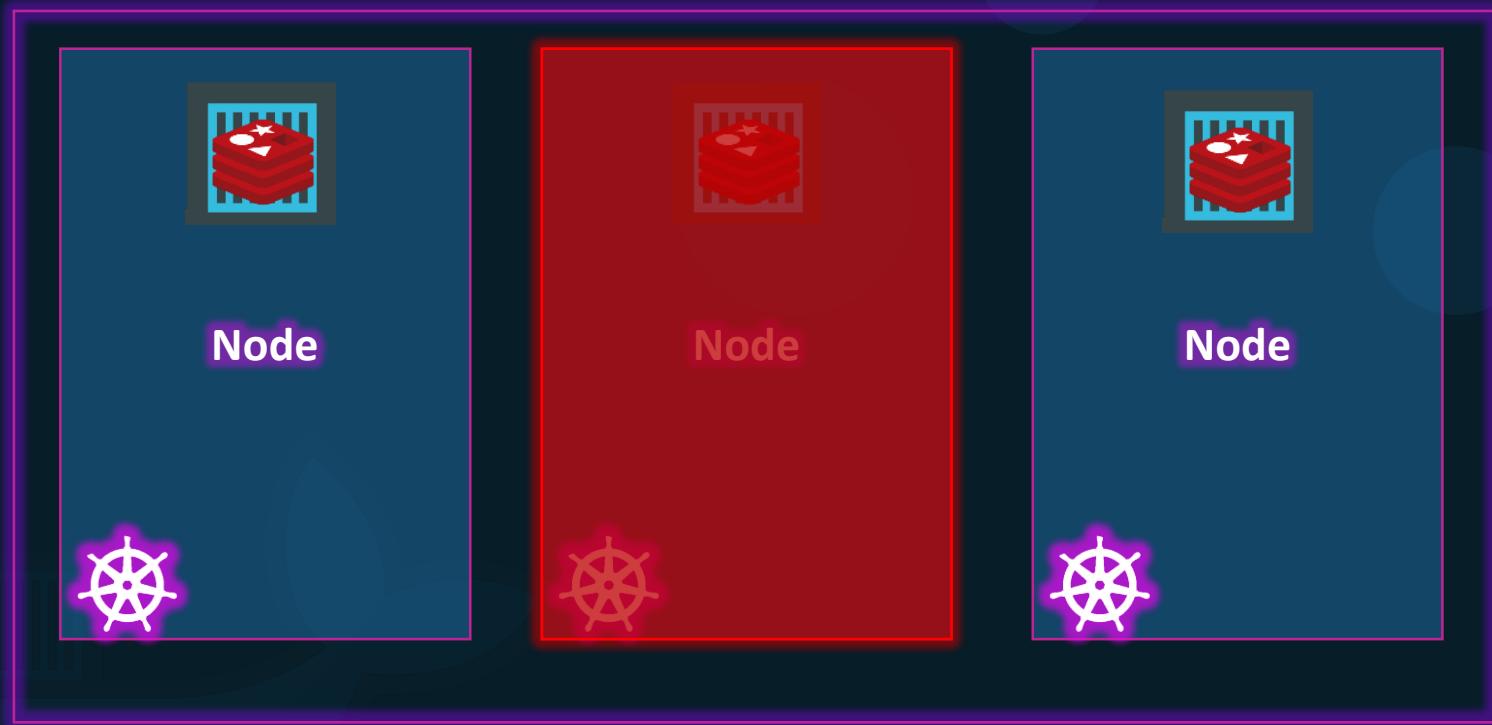




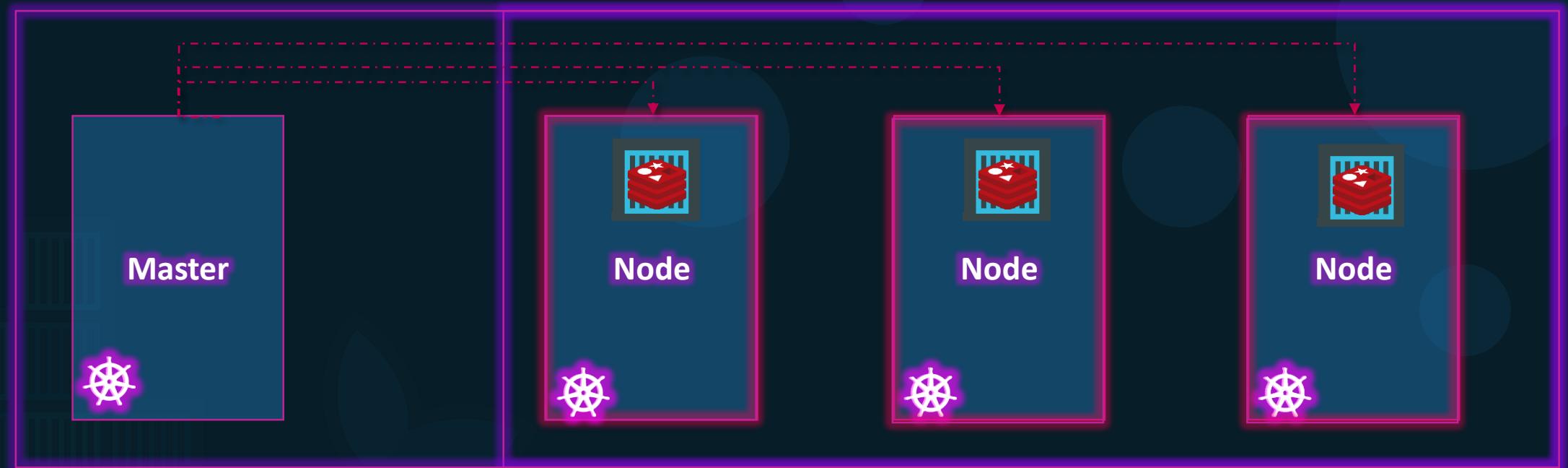
Nodes (Minions)



Cluster



Master



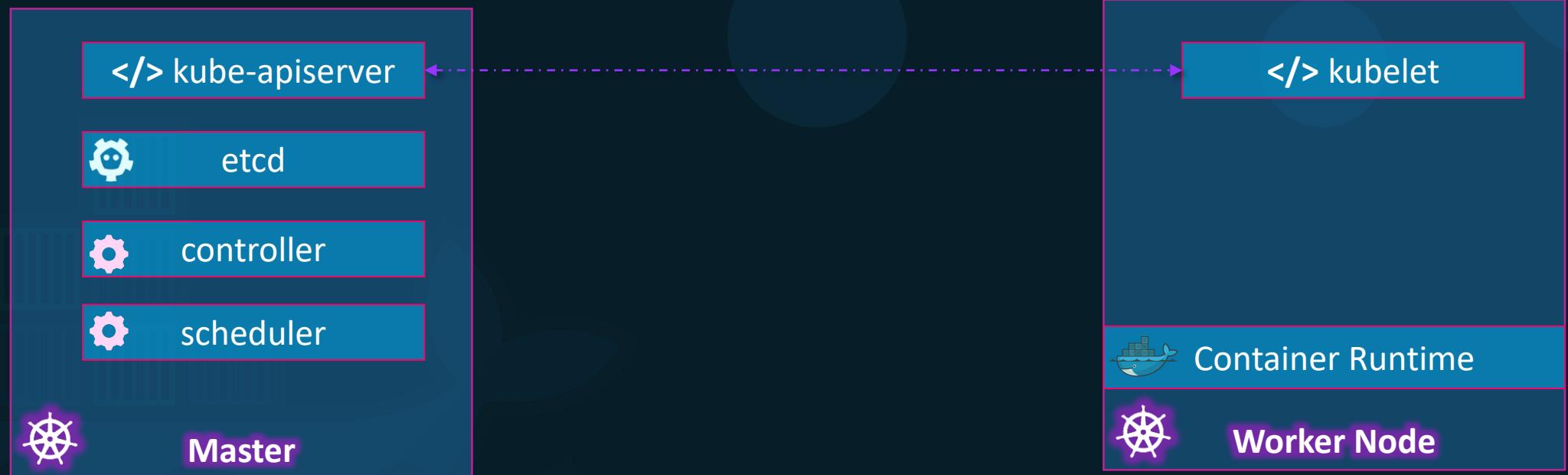
Components



Key-value store



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
```



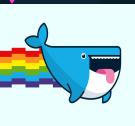
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CONCLUSION



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THANK YOU

