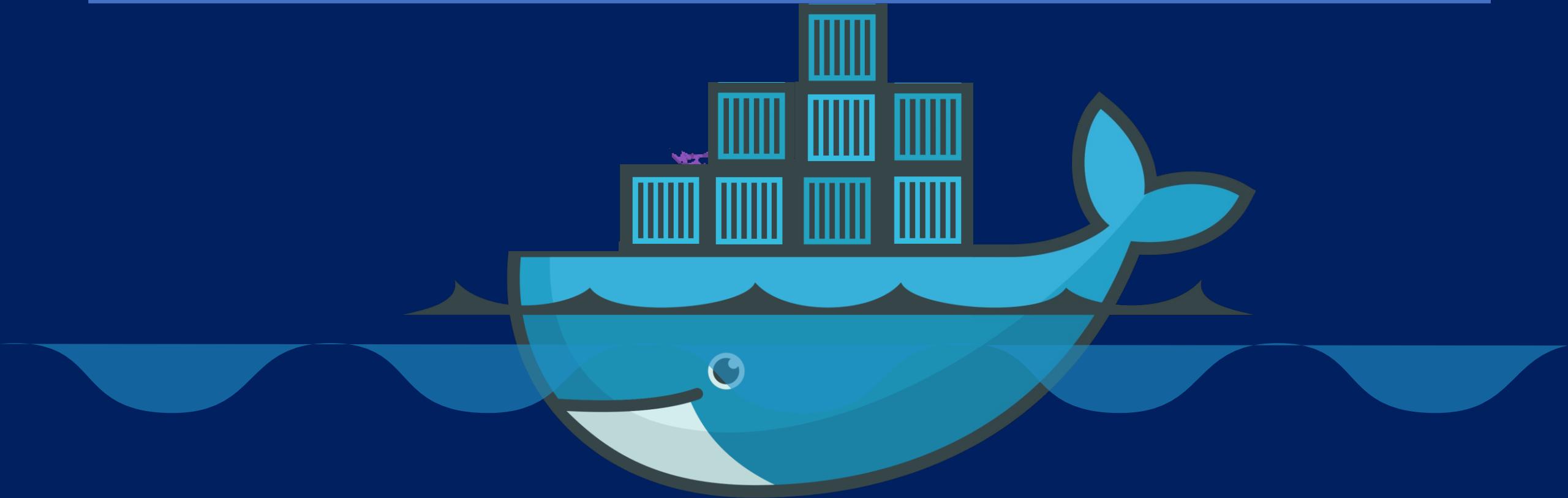




Week 10 : SOFTWARE DEVELOPMENT TOOLS AND ENVIRONMENTS

# Dockerfile and Docker Image

---



# Dockerfile

- Dockerfile is instructions to build Docker Image
  - How to run commands
  - Add files or directories
  - Create environment variables
  - What process to run when launching container
- Result from building Dockerfile is Docker Image



Dockerfile

# Sample Dockerfile

```
FROM node:14.15.0-alpine3.12 ← OS + System Packages
COPY . /nodejs/.           ← Source Code
WORKDIR /nodejs
RUN npm install             ← Library Dependencies
ENV VERSION 1.0            ← Configuration
EXPOSE 8081
CMD ["node", "/nodejs/main.js"]
```

## Dockerfile reference

FROM <image:tag>	Sets the base image for subsequent instructions.
RUN <command>	Execute any commands in image.
CMD <command> <param1> <param2>	Sets the command to be executed when running the image.
LABEL <key>=<value> ...	Adds metadata to an image.
EXPOSE <port>	Informs Docker that the container listens on the specified network ports at runtime.
ENV <key> <value>	Sets the environment variable.
COPY <src> <dest>	Copies new files from source to the filesystem of the container at the path destinations.
ENTRYPOINT <command> <param1> <param2>	Command line arguments will be appended after all elements in an exec form ENTRYPOINT.
VOLUME ["/data"]	Sets mounted volumes from native host or other containers.
WORKDIR <path>	Sets the working directory for any commands.

# 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
```



# Dockerfile

Dockerfile

INSTRUCTION

ARGUMENT

Dockerfile

FROM Ubuntu

Start from a base OS or another image

RUN apt-get update

RUN apt-get install python

Install all dependencies

RUN pip install flask

RUN pip install flask-mysql

COPY . /opt/source-code

Copy source code

ENTRYPOINT FLASK\_APP=/opt/source-code/app.py flask run

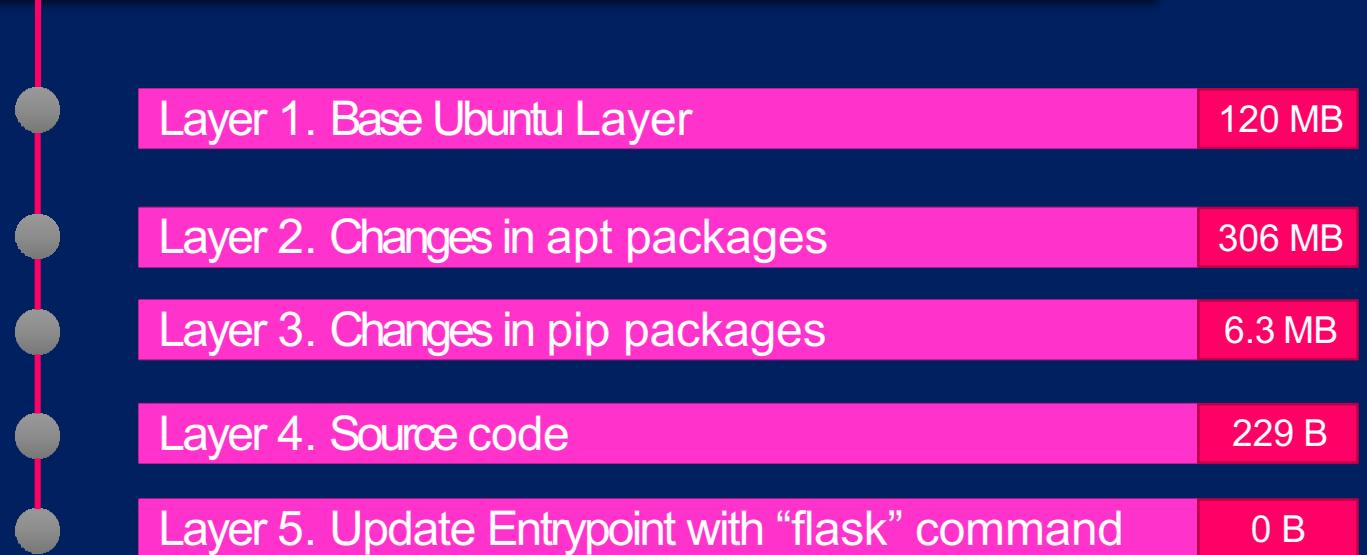
Specify Entrypoint

# 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 mmumshad/my-custom-app



```
root@osboxes:/root/simple-webapp-docker # docker history mmumshad/simple-webapp  
IMAGE          CREATED      CREATED BY                                         SIZE        COMMENT  
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

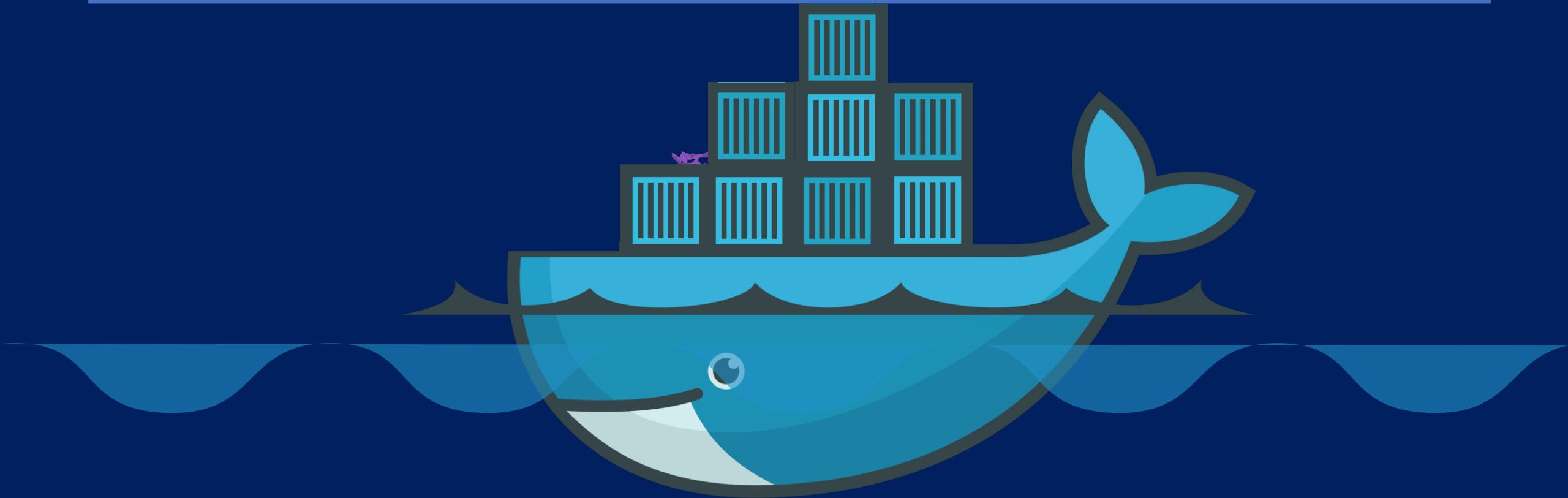
Layer 5. Update Entrypoint with “flask” command

```
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
```

# Docker registry

---



# Image

```
▶ docker run nginx
```

# Image

docker.io  
Docker Hub

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



Registry      User/    Image/  
                  Account Repository

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

# Private Registry

```
▶ docker login hub.docker.com
```

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 build -t <your-dockerhub-username>/<image_repository_name>:tag .
```

```
docker push <your-dockerhub-username>/<image_repository_name>:tag
```

```
docker pull <your-dockerhub-username>/<image_repository_name>:tag
```

# How to rename image with Docker tag

- . Build a Docker image with a tag:

```
perl
```

 Copy code

```
docker build -t my-lab:1.0 .
```

This builds a Docker image with the name `my-lab` and the tag `1.0`.

- . Rename the Docker image with a new tag:

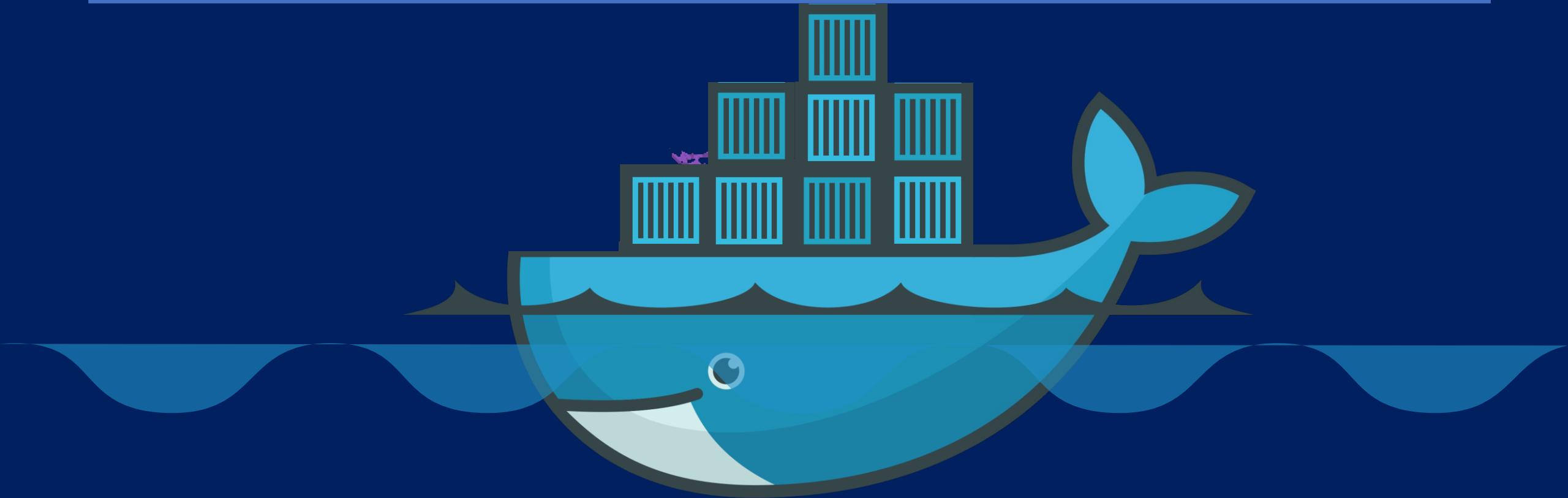
```
perl
```

 Copy code

```
docker tag my-lab:1.0 my-registry/my-lab:latest
```

# Docker Network

---



# Default networks



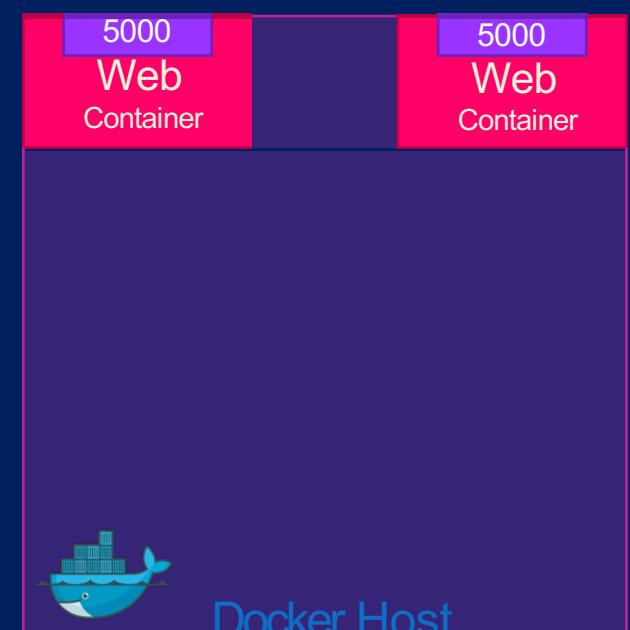
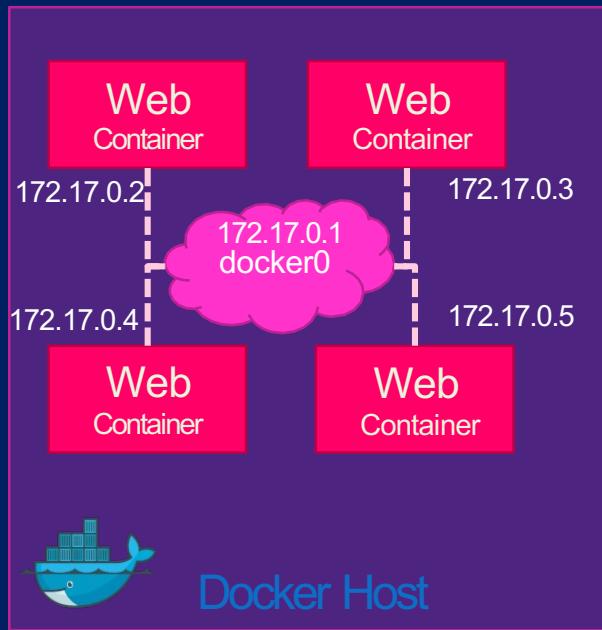
```
docker run ubuntu
```



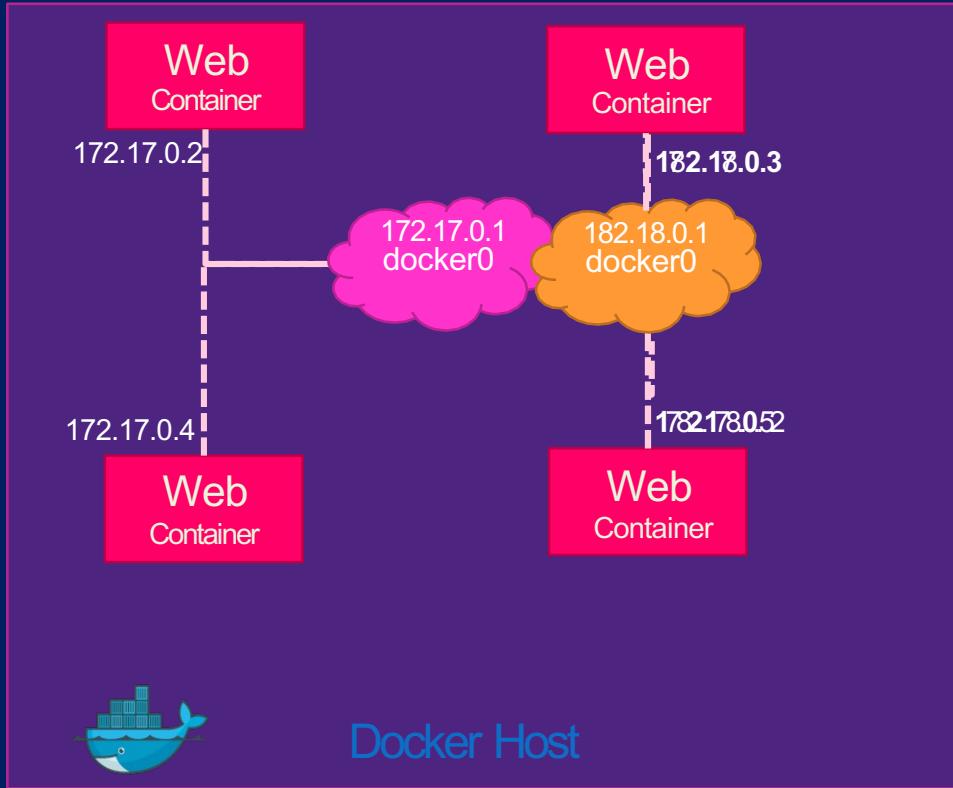
```
docker run Ubuntu --network=none
```



```
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

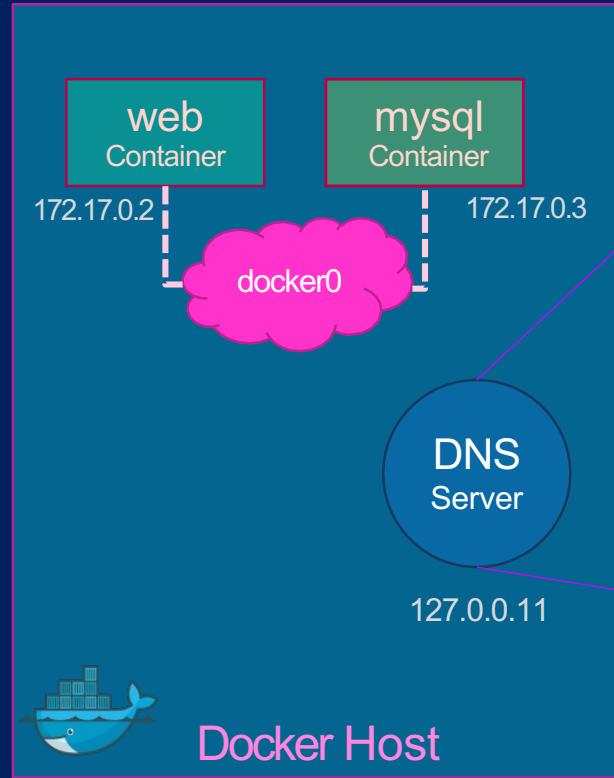
# Inspect Network

```
▶ 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

# Lab Docker Network with Subnet

This guide explains how to create a lab Docker network with a specific subnet using a busybox container.

- 1. Create a new Docker network named "lab\_network" with a specific subnet, e.g., 192.168.100.0/24, using the following command:**

```
docker network create --subnet 192.168.100.0/24 lab_network
```

- 2. To confirm that the "lab\_network" has been created and to view its settings, run the following command:**

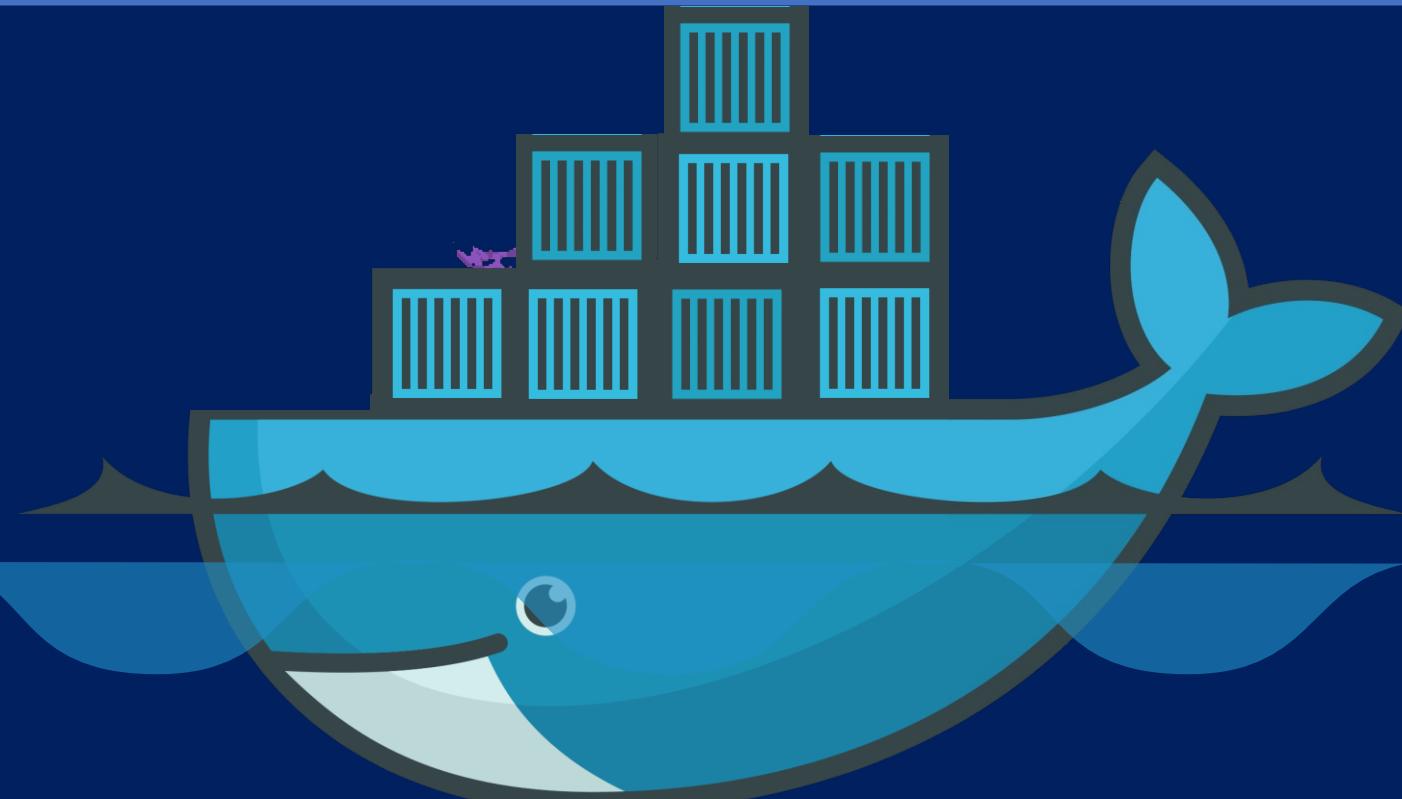
```
docker network inspect lab_network
```

- 3. Run a new container with the busybox image and connect it to the "lab\_network" using the following command:**

```
docker run --name busybox_container --network lab_network busybox
```

# Docker compose

---



# Docker compose

```
docker run yourname/simple-webapp
```

```
docker run mongodb
```

```
docker run redis:alpine
```

```
docker run ansible
```

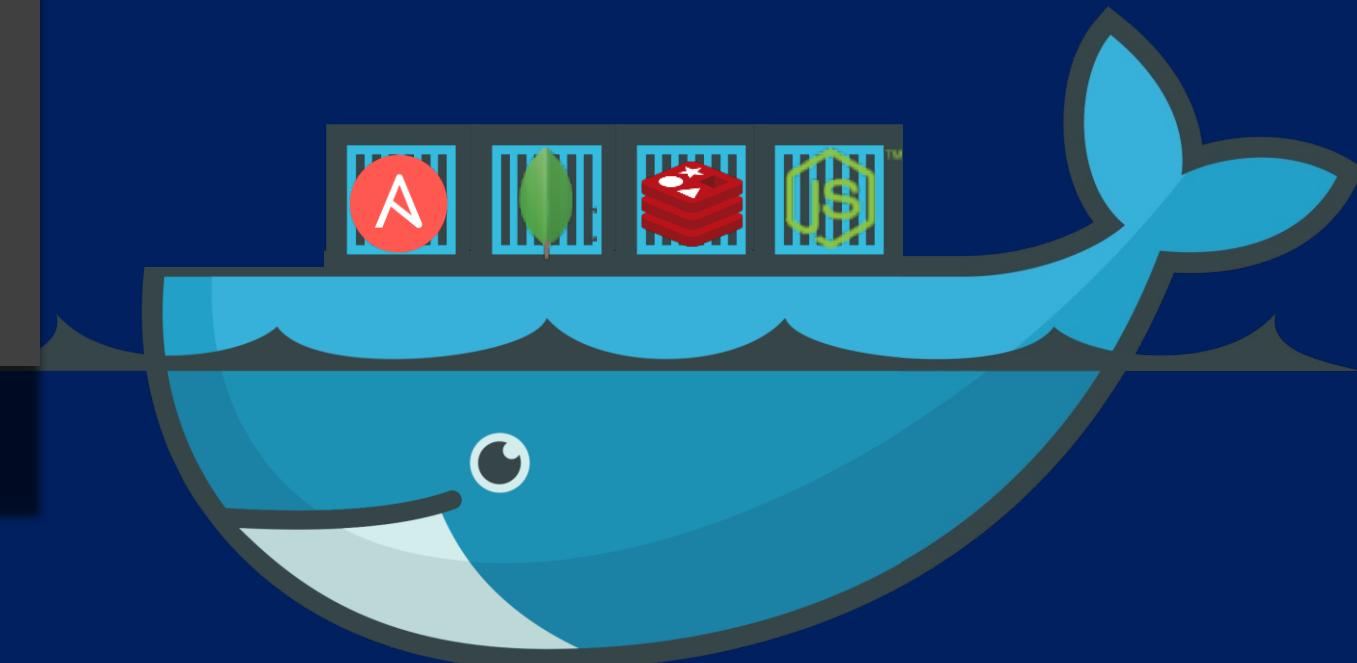
```
docker-compose.yml
```

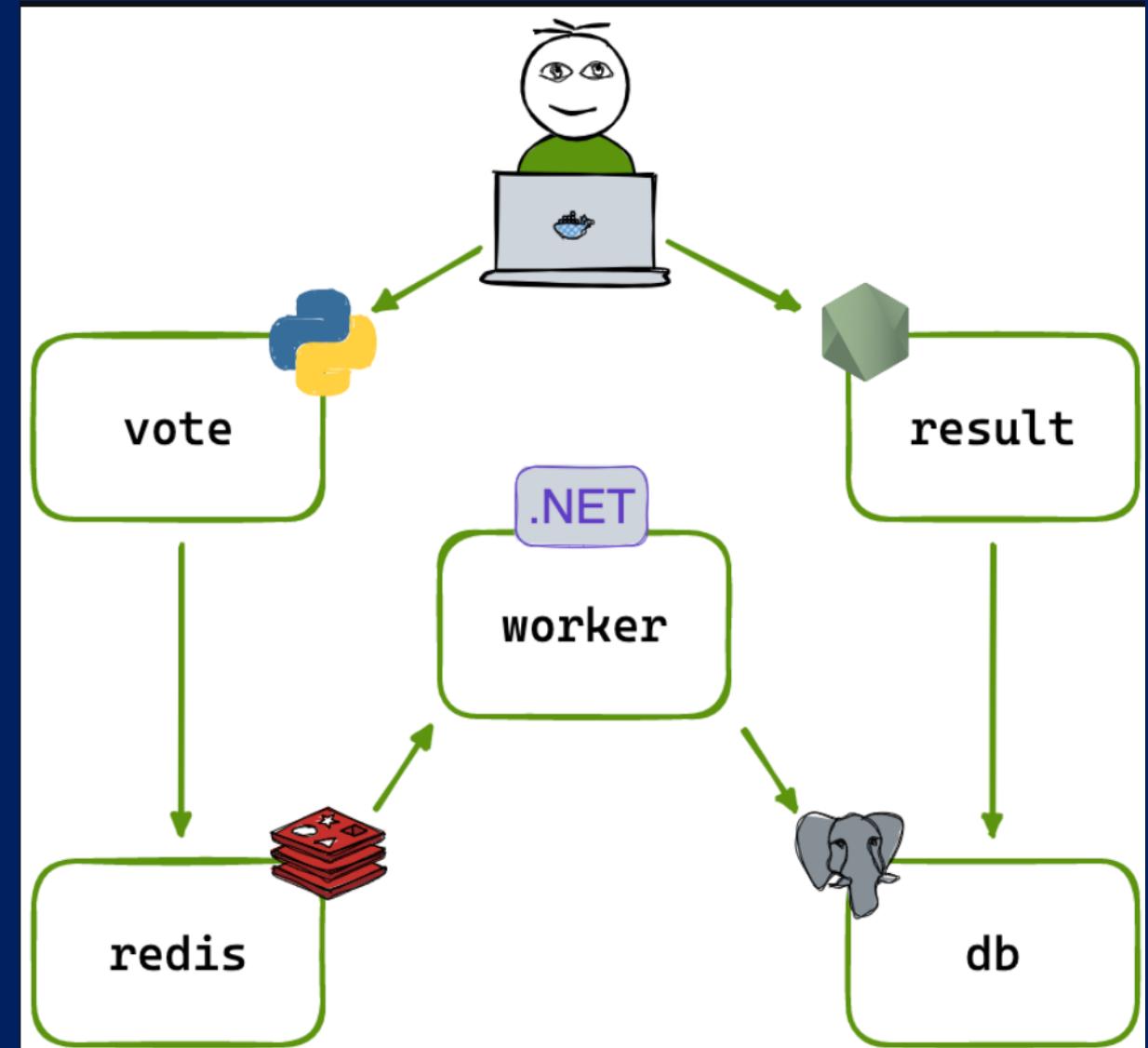
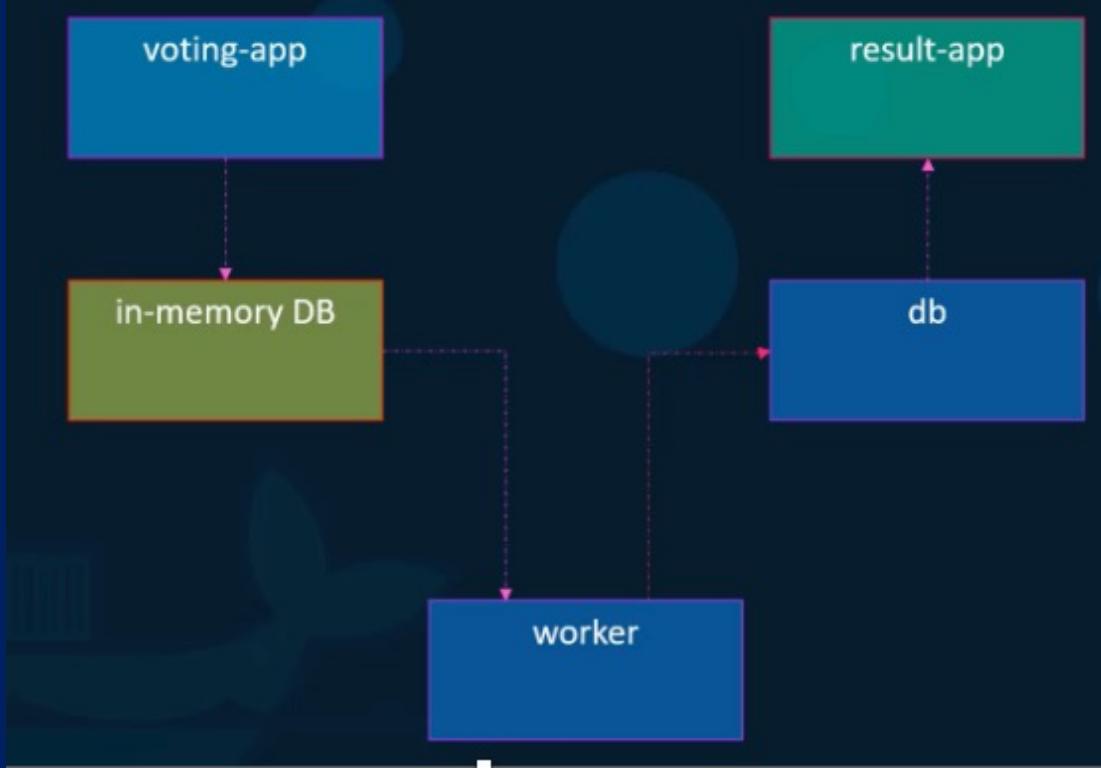
```
services:  
  web:  
    image: "yourname/simple-webapp"  
  database:  
    image: "mongodb"  
  messaging:  
    image: "redis:alpine"  
  orchestration:  
    image: "ansible"
```

```
docker-compose up
```



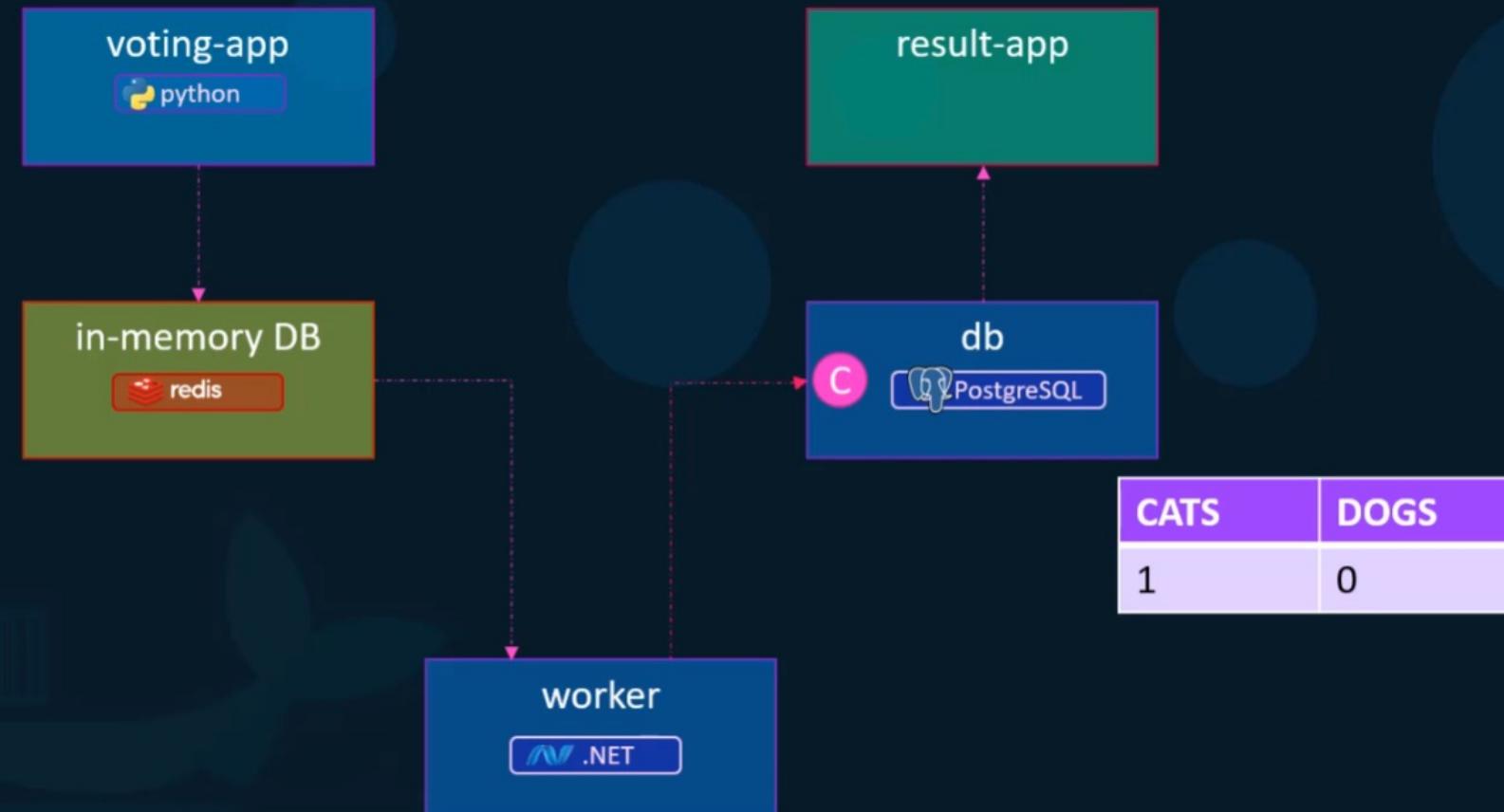
Public Docker registry - dockerhub



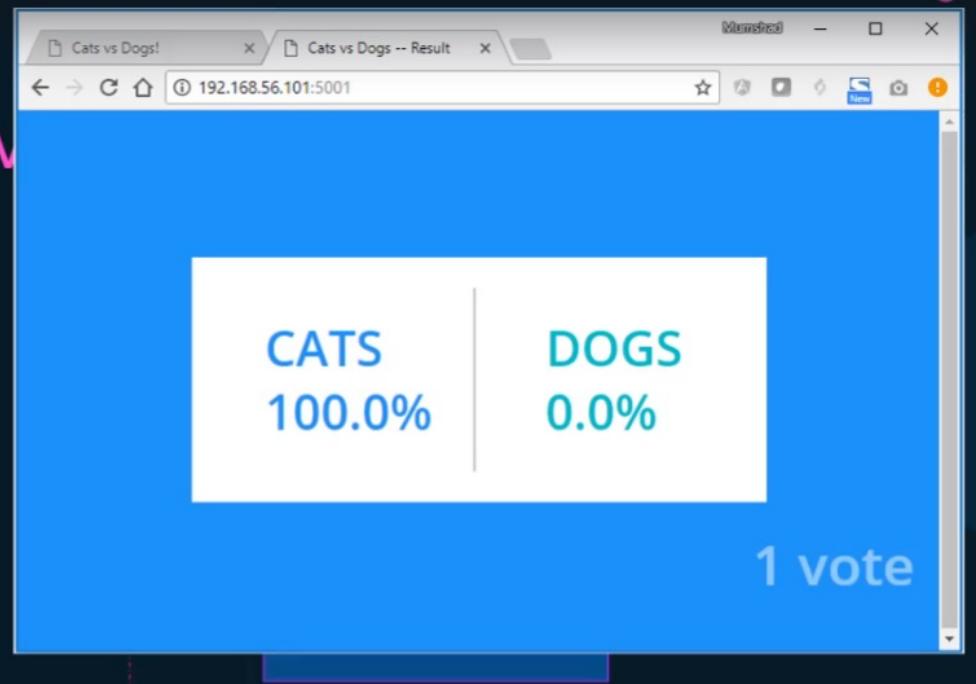
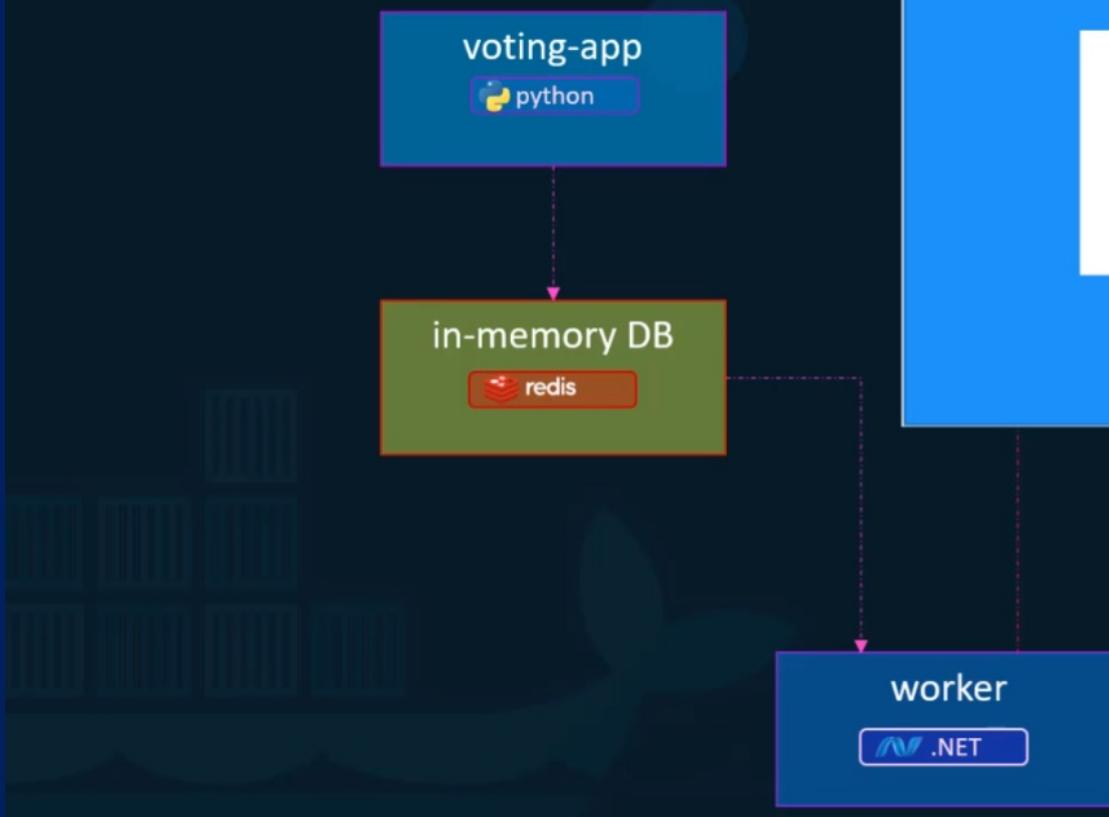


- A front-end web app in [Python](#) which lets you vote between two options
- A [Redis](#) which collects new votes
- A [.NET](#) worker which consumes votes and stores them in...
- A [Postgres](#) database backed by a Docker volume
- A [Node.js](#) web app which shows the results of the voting in real time

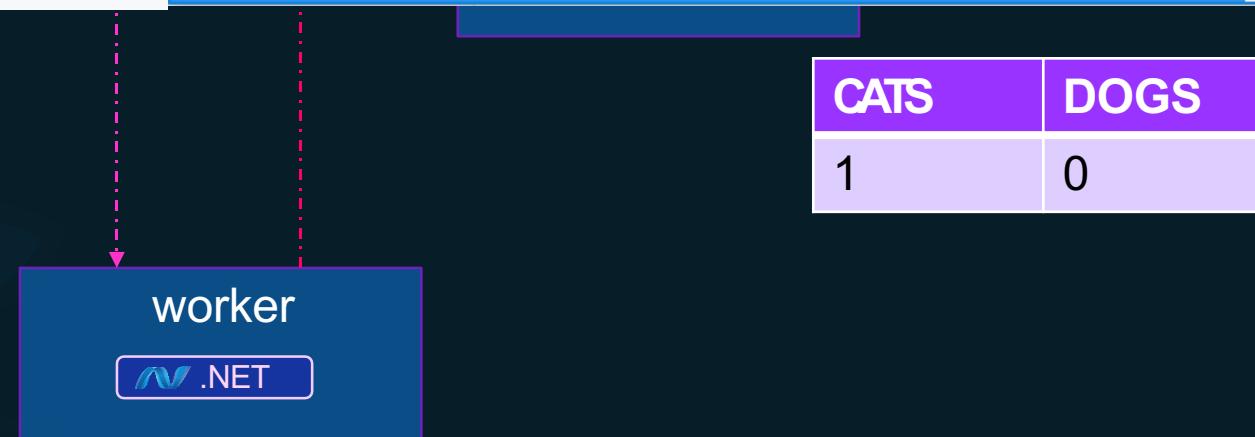
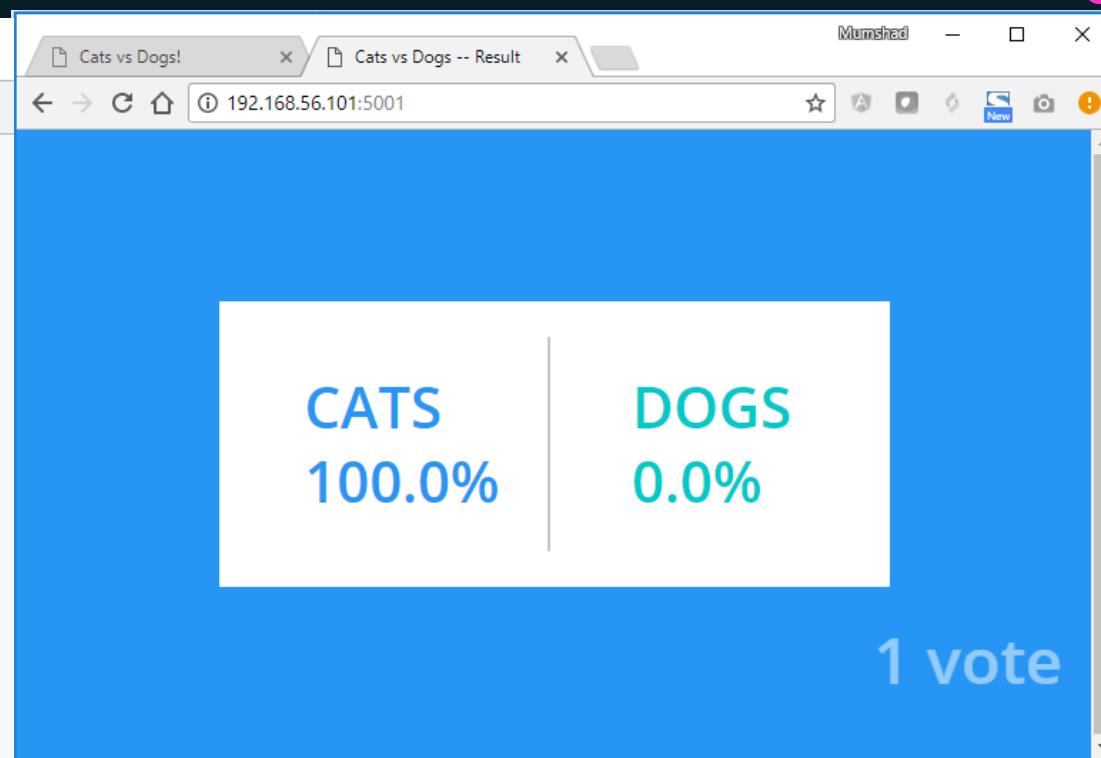
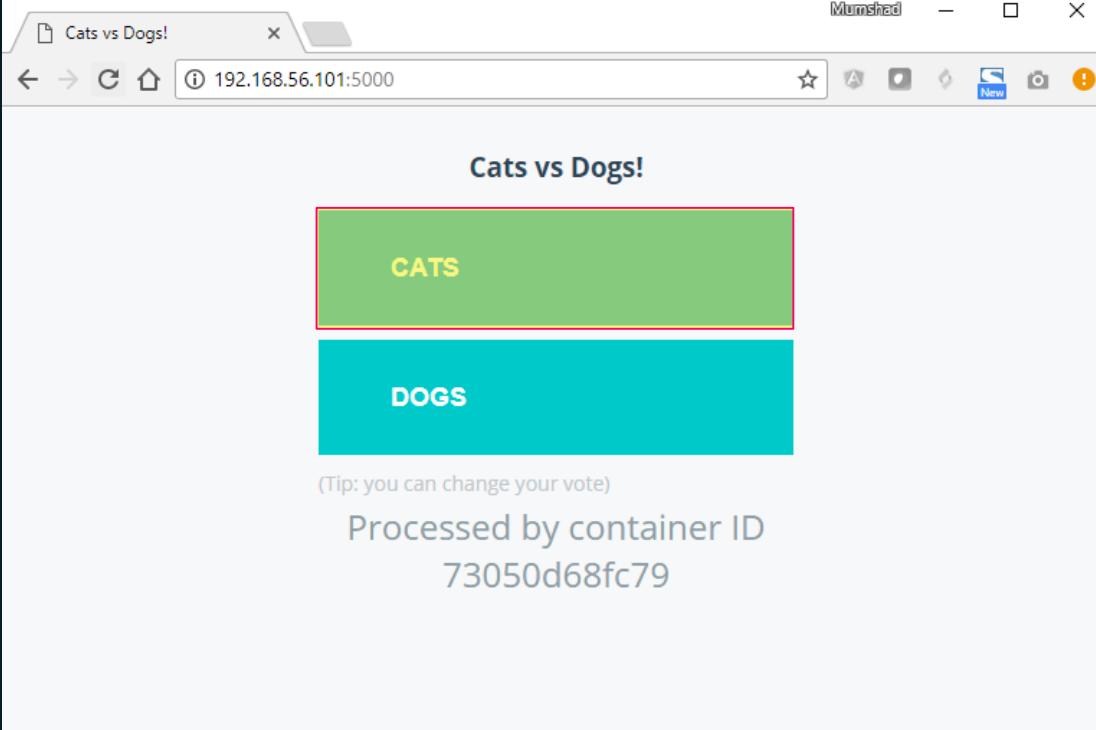
# Sample application – voting application



# Sample application – voting



CATS	DOGS
1	0



# docker run

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



# docker run

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

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

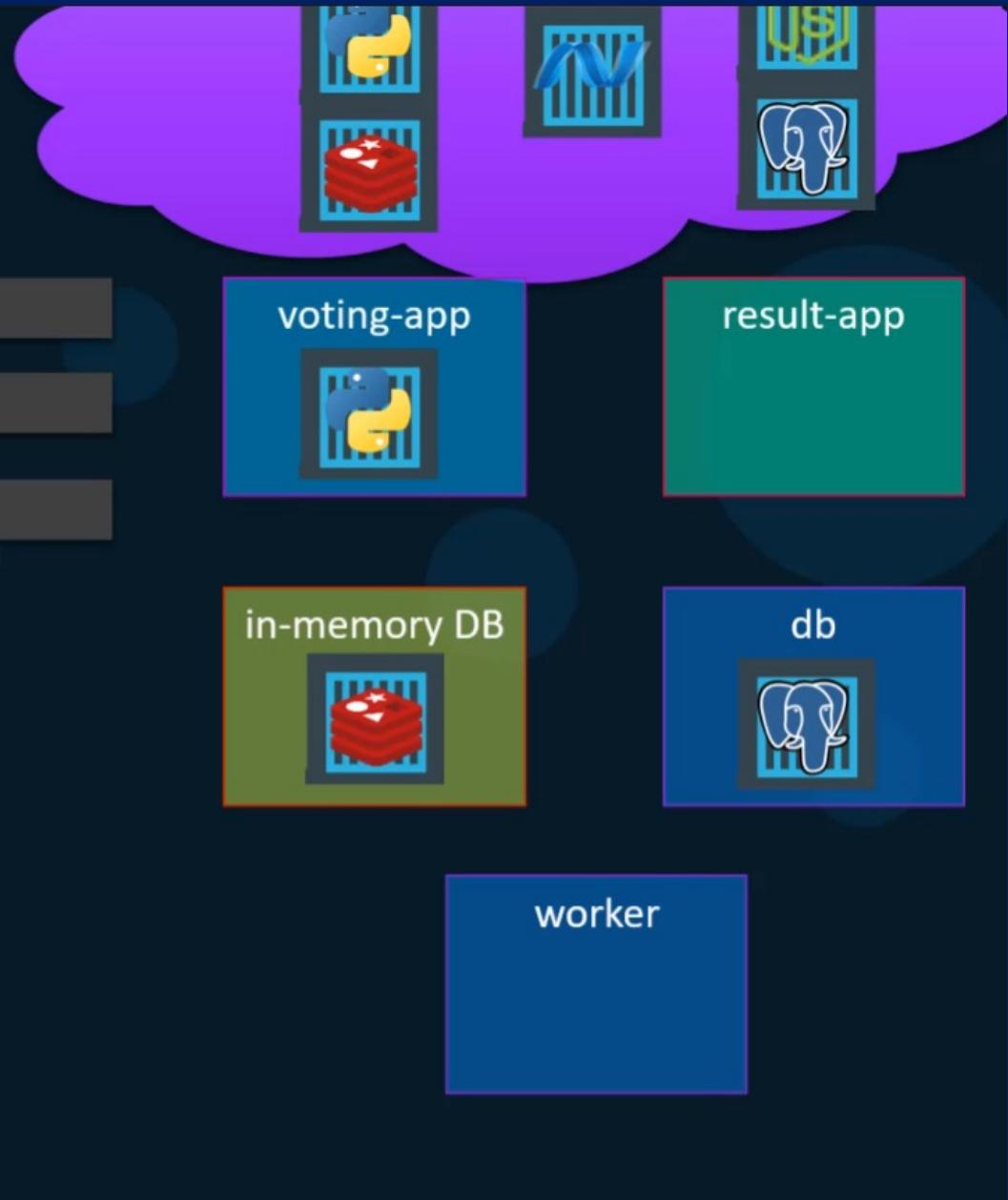


# docker run

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

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

```
docker run -d --name=vote -p 5000:80 voting-app
```



# docker run

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

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

```
docker run -d --name=vote -p 5000:80 voting-app
```

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



# docker run

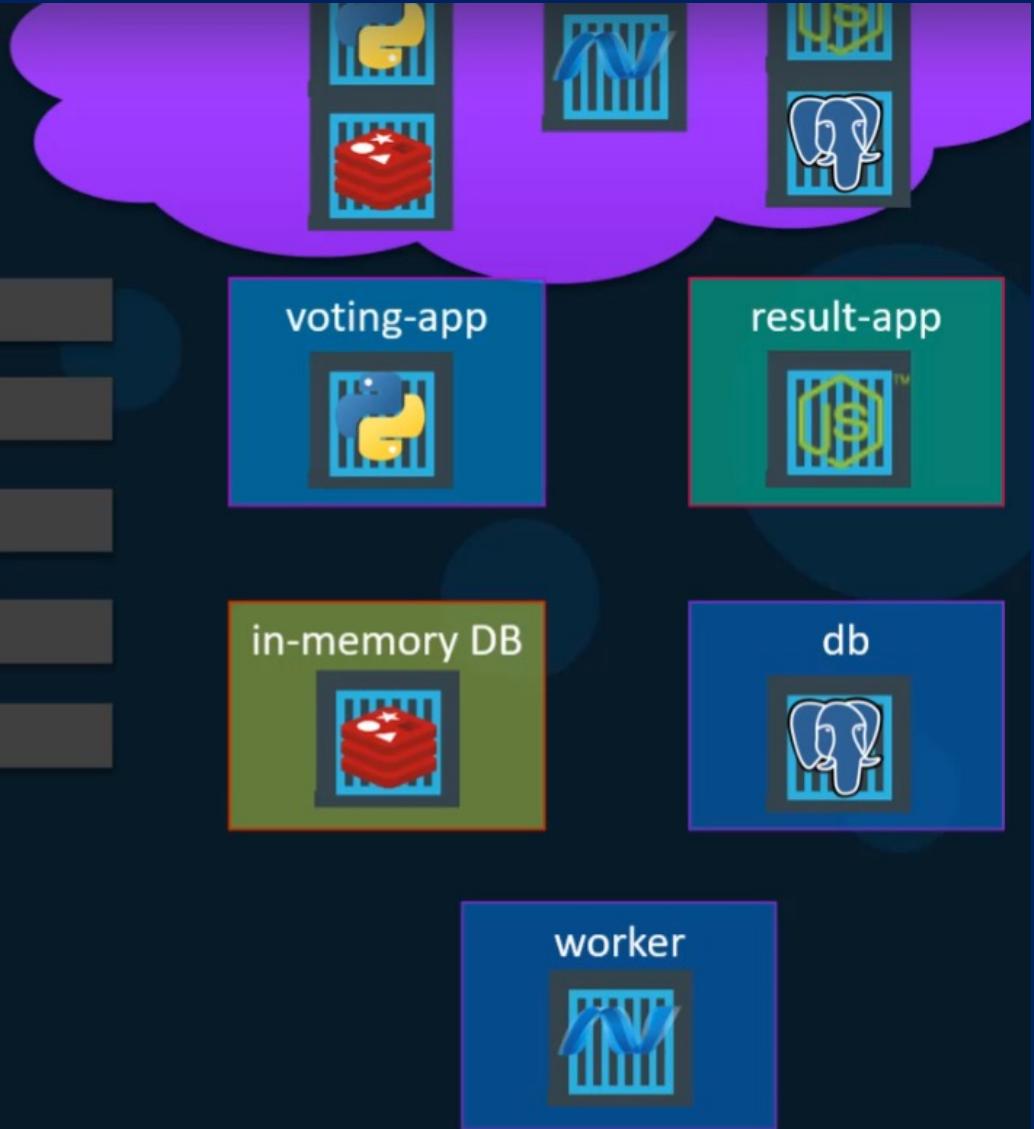
```
docker run -d --name=redis redis
```

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

```
docker run -d --name=vote -p 5000:80 voting-app
```

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

```
docker run -d --name=worker worker
```



# docker run

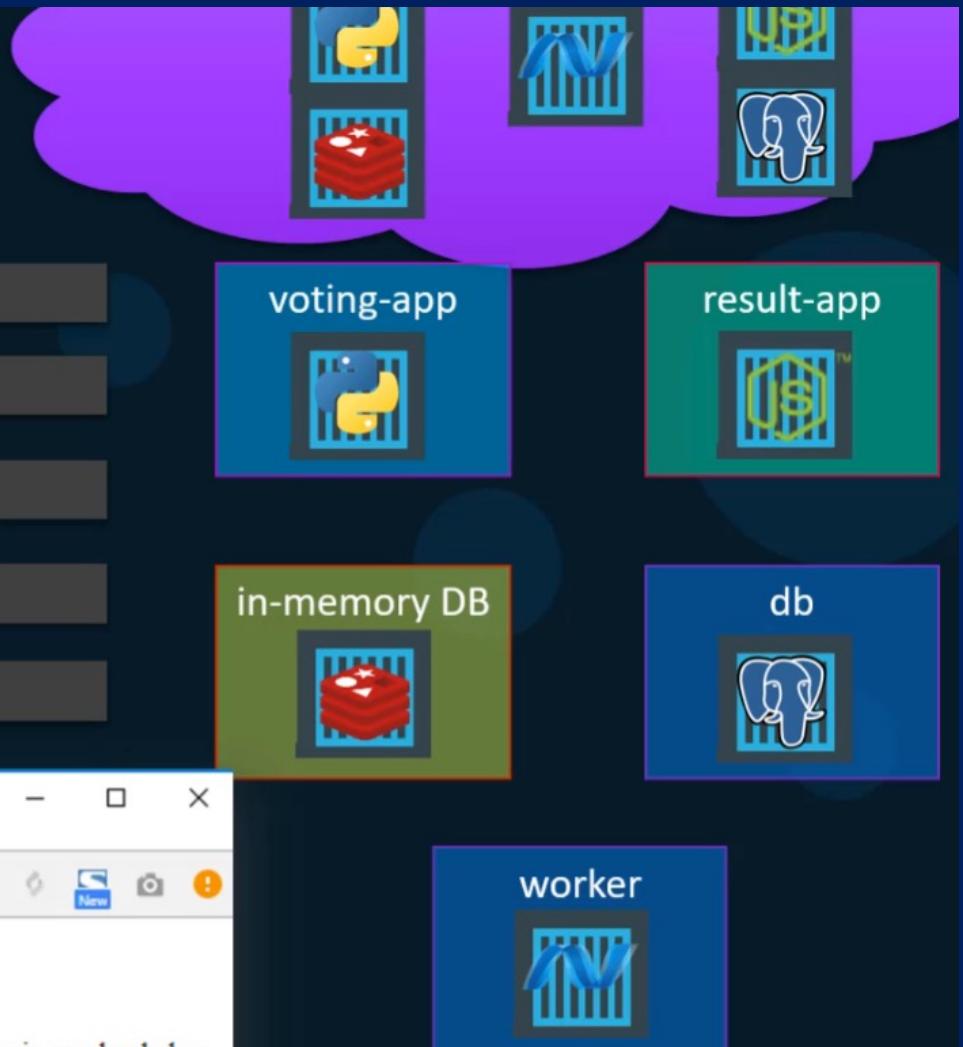
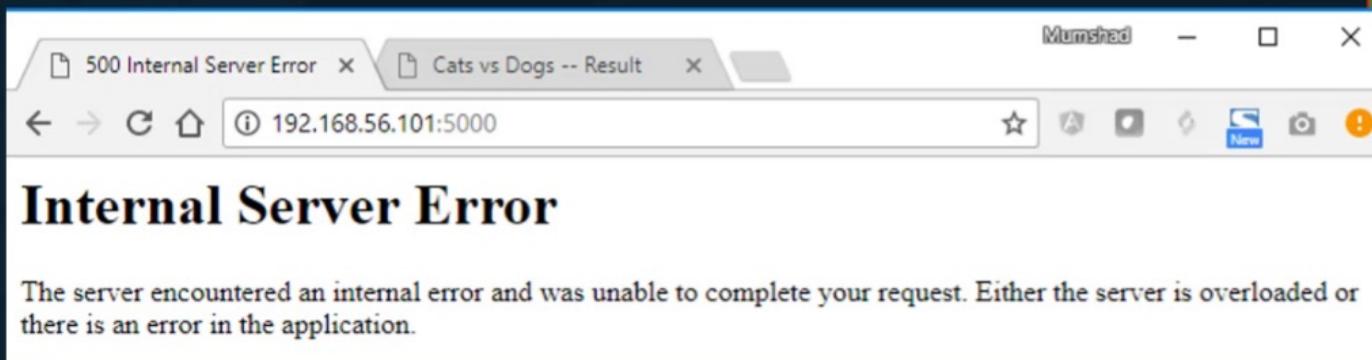
```
docker run -d --name=redis redis
```

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

```
docker run -d --name=vote -p 5000:80 voting-app
```

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

```
docker run -d --name=worker worker
```



# docker run --links

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

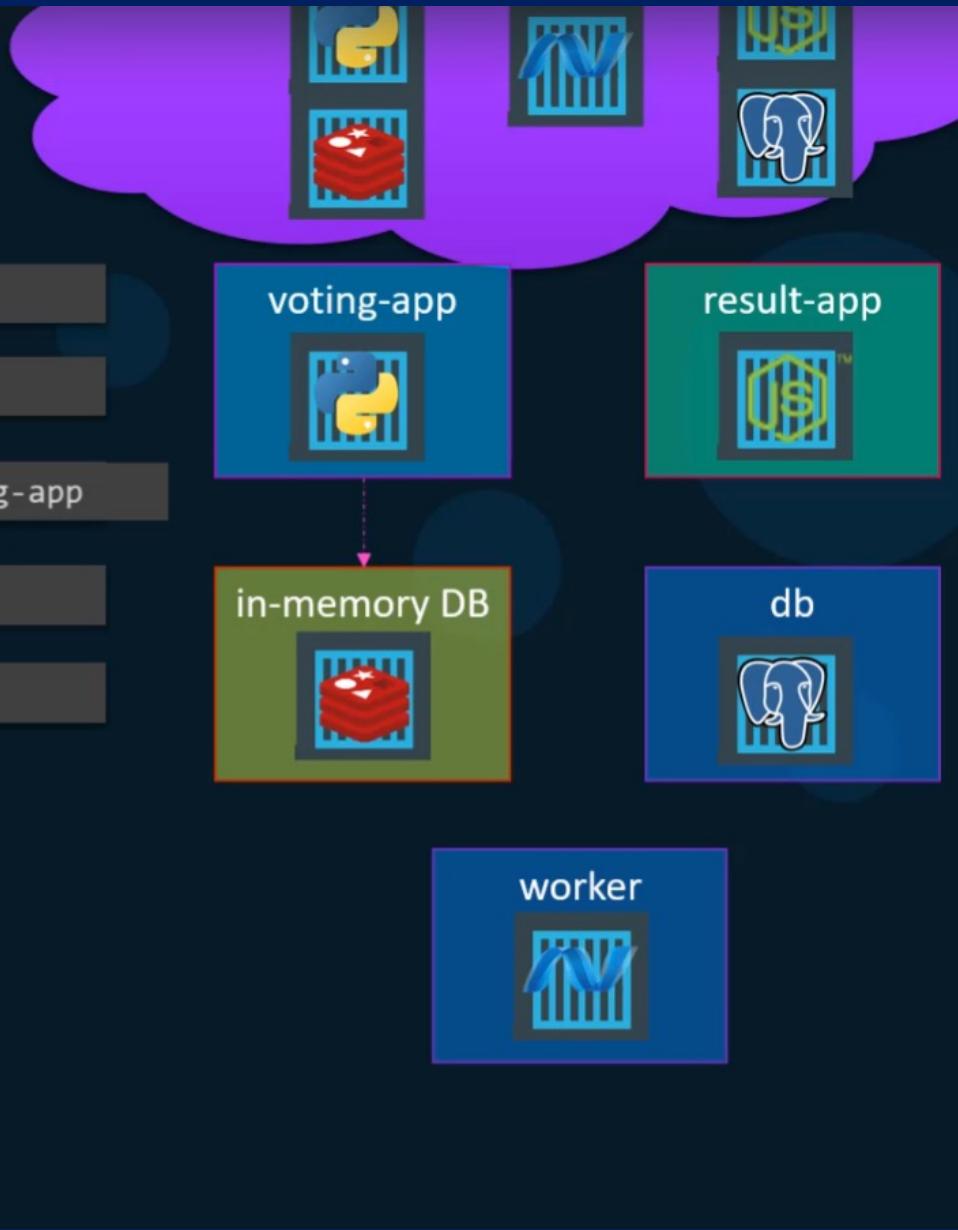
```
docker run -d --name=db postgres
```

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

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

```
docker run -d --name=worker worker
```

```
def get_redis():
    if not hasattr(g, 'redis'):
        g.redis = Redis(host="redis", db=0, socket_timeout=5)
    return g.redis
```



# docker run --links

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

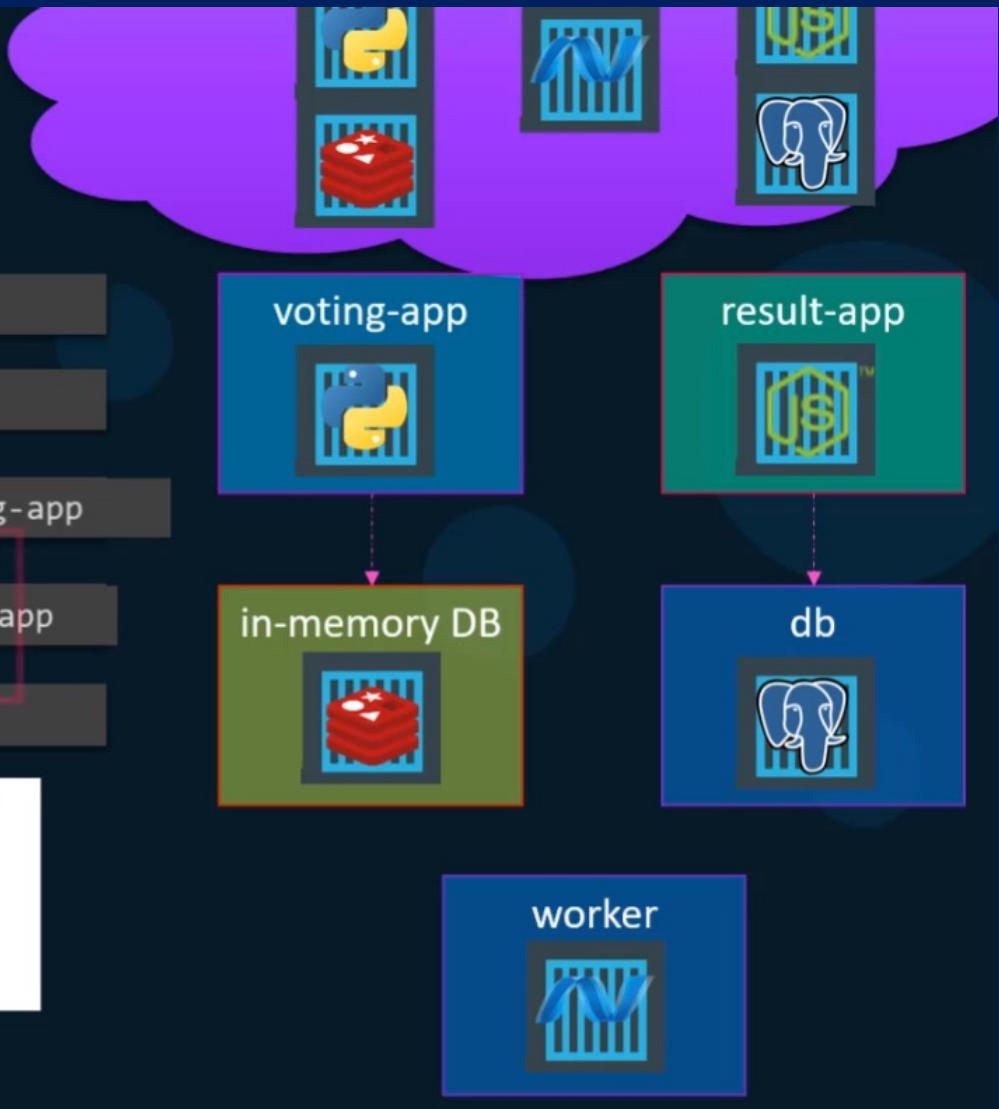
```
docker run -d --name=db postgres
```

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

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

```
docker run -d --name=worker worker
```

```
pg.connect('postgres://postgres@db/postgres', function(err, client, done) {  
  if (err) {  
    console.error("Waiting for db");  
  }  
  callback(err, client);  
});
```



# docker run --links

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

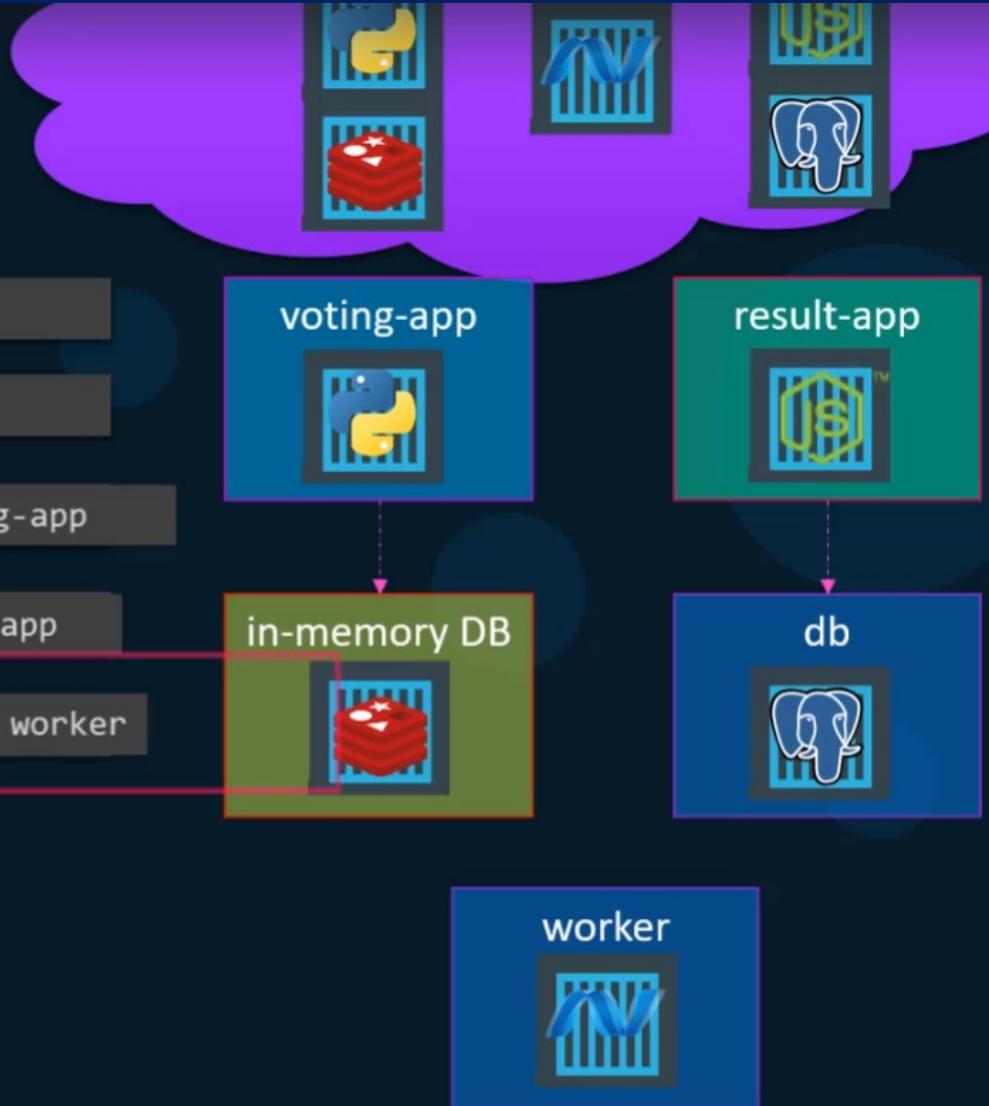
```
docker run -d --name=db postgres
```

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

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

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

```
try {  
    Jedis redis = connectToRedis("redis");  
    Connection dbConn = connectToDB("db");  
  
    System.out.println("Watching vote queue");
```



# Docker compose

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

```
docker run -d --name=db postgres:9.4
```

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

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

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

```
docker-compose.yml
```

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

# 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
```

SOFTWARE-DEVELOPMENT-TOOLS-AND-ENVIRONMENTS / Week10 / Lab_docker_compose / vote /	
 Tuchsanai	0
Name	Last commit message
 ..	0
 static/stylesheets	0
 templates	0
 Dockerfile	0
 app.py	0
 requirements.txt	0

# 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

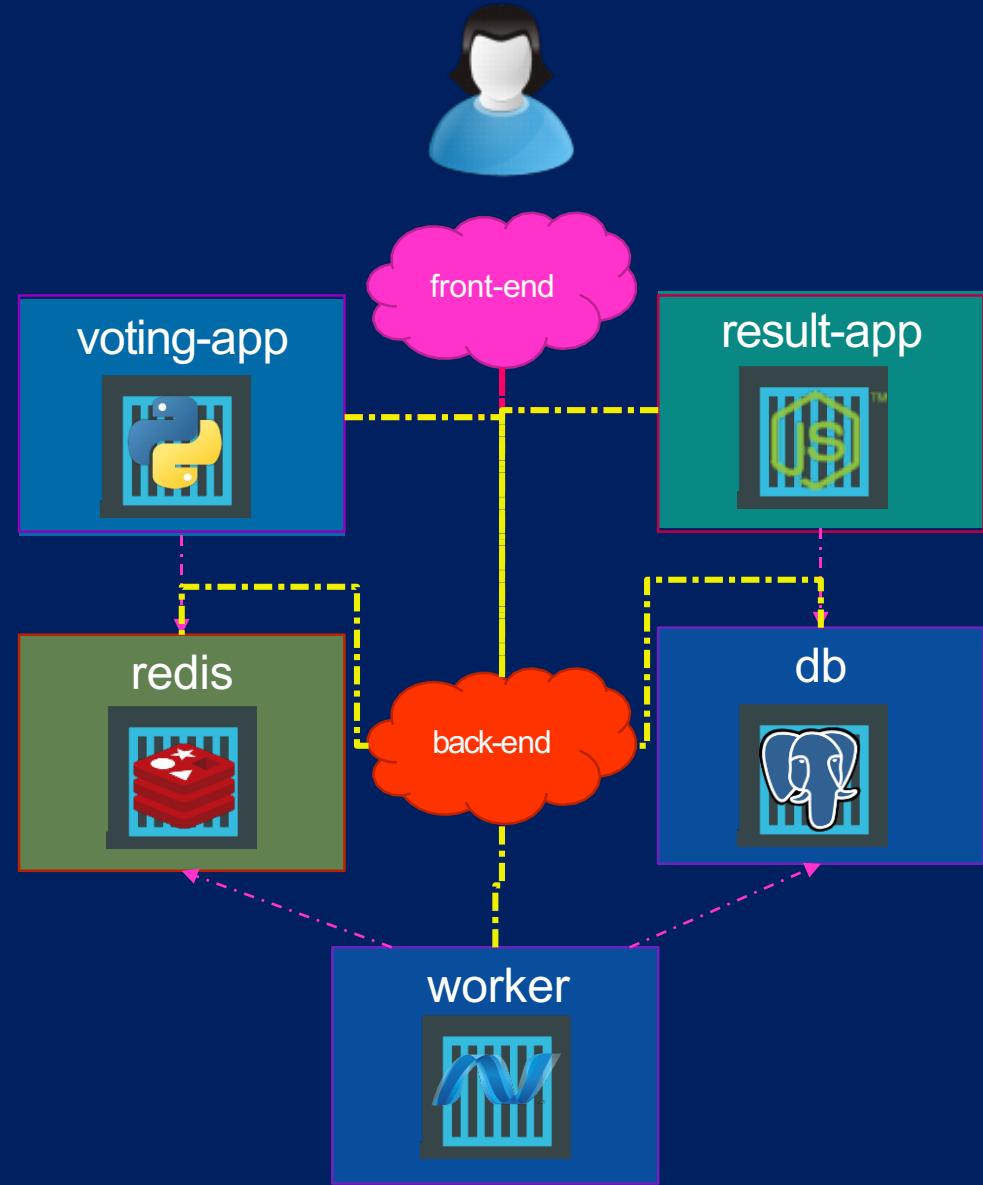
```
version: 3  
services:  
    redis:  
        image: redis  
  
    db:  
        image: postgres:9.4  
  
    vote:  
        image: voting-app  
        ports:  
            - 5000:80
```

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:
```



```
redis:
  image: redis:alpine
  volumes:
    - "./healthchecks:/healthchecks"
  healthcheck:
    test: /healthchecks/redis.sh
    interval: "5s"
  networks:
    - back-tier

db:
  image: postgres:15-alpine
  environment:
    POSTGRES_USER: "postgres"
    POSTGRES_PASSWORD: "postgres"
  volumes:
    - "db-data:/var/lib/postgresql/data"
    - "./healthchecks:/healthchecks"
  healthcheck:
    test: /healthchecks/postgres.sh
    interval: "5s"
  networks:
    - back-tier
```

```
vote:
  build: ./vote
  # use python rather than gunicorn for local dev
  command: python app.py
  depends_on:
    redis:
      condition: service_healthy
  healthcheck:
    test: ["CMD", "curl", "-f", "http://localhost"]
    interval: 15s
    timeout: 5s
    retries: 3
    start_period: 10s
  volumes:
    - ./vote:/app
  ports:
    - "5000:80"
  networks:
    - front-tier
    - back-tier

result:
  build: ./result
  # use nodemon rather than node for local dev
  entrypoint: nodemon server.js
  depends_on:
    db:
      condition: service_healthy
  volumes:
    - ./result:/app
  ports:
    - "5001:80"
    - "5858:5858"
  networks:
    - front-tier
    - back-tier
```

## postgres.sh

```
#!/bin/bash
set -eo pipefail

host="$(hostname -i || echo '127.0.0.1')"
user="${POSTGRES_USER:-postgres}"
db="${POSTGRES_DB:-$POSTGRES_USER}"
export PGPASSWORD="${POSTGRES_PASSWORD:-}"

args=(
    # force postgres to not use the local unix socket (test "external" connectivity)
    --host "$host"
    --username "$user"
    --dbname "$db"
    --quiet --no-align --tuples-only
)

if select="$(echo 'SELECT 1' | psql "${args[@]}")" && [ "$select" = '1' ]; then
    exit 0
fi

exit 1
```

## redis.sh

```
1  #!/bin/sh
2  set -eo pipefail
3
4  host="$(hostname -i || echo '127.0.0.1')"
5
6  if ping="$(redis-cli -h "$host" ping)" && [ "$ping" = 'PONG' ]; then
7      exit 0
8  fi
9
10 exit 1
```



You can run a Python script from within a shell script using the `python` command and capture its output using command substitution.

Here's an example:

bash

Copy code

```
#!/bin/bash

# Run Python script and capture its output
output=$(python my_python_script.py)

# Print the output
echo $output
```

In this example, the shell script runs a Python script called `my\_python\_script.py` and captures its output into a variable called `output`. The `echo` command then prints the contents of the `output` variable.

You can modify this script to suit your specific needs by replacing `my\_python\_script.py` with the path to your Python script and modifying the `echo` command to do something else with the output.

## **docker-compose up**

This command is used to start the containers defined in the docker-compose.yml file. If the containers don't exist, they will be created.

```
docker-compose up
```

## **docker-compose down**

This command is used to stop and remove the containers defined in the docker-compose.yml file.

```
docker-compose down
```

To delete all networks, images, and volumes with Docker Compose, you can use the following commands:

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

- The `--rmi all` flag tells Docker to remove all images associated with the containers.
- The `--volumes` flag tells Docker to remove any volumes associated with the containers.
- The `--remove-orphans` flag tells Docker to remove any containers that were not defined in the docker-compose.yml file.

```
docker network prune  
docker volume prune
```

- The second command (`docker network prune`) will remove any unused networks.
- The third command (`docker volume prune`) will remove any unused volumes.