Web Application Development

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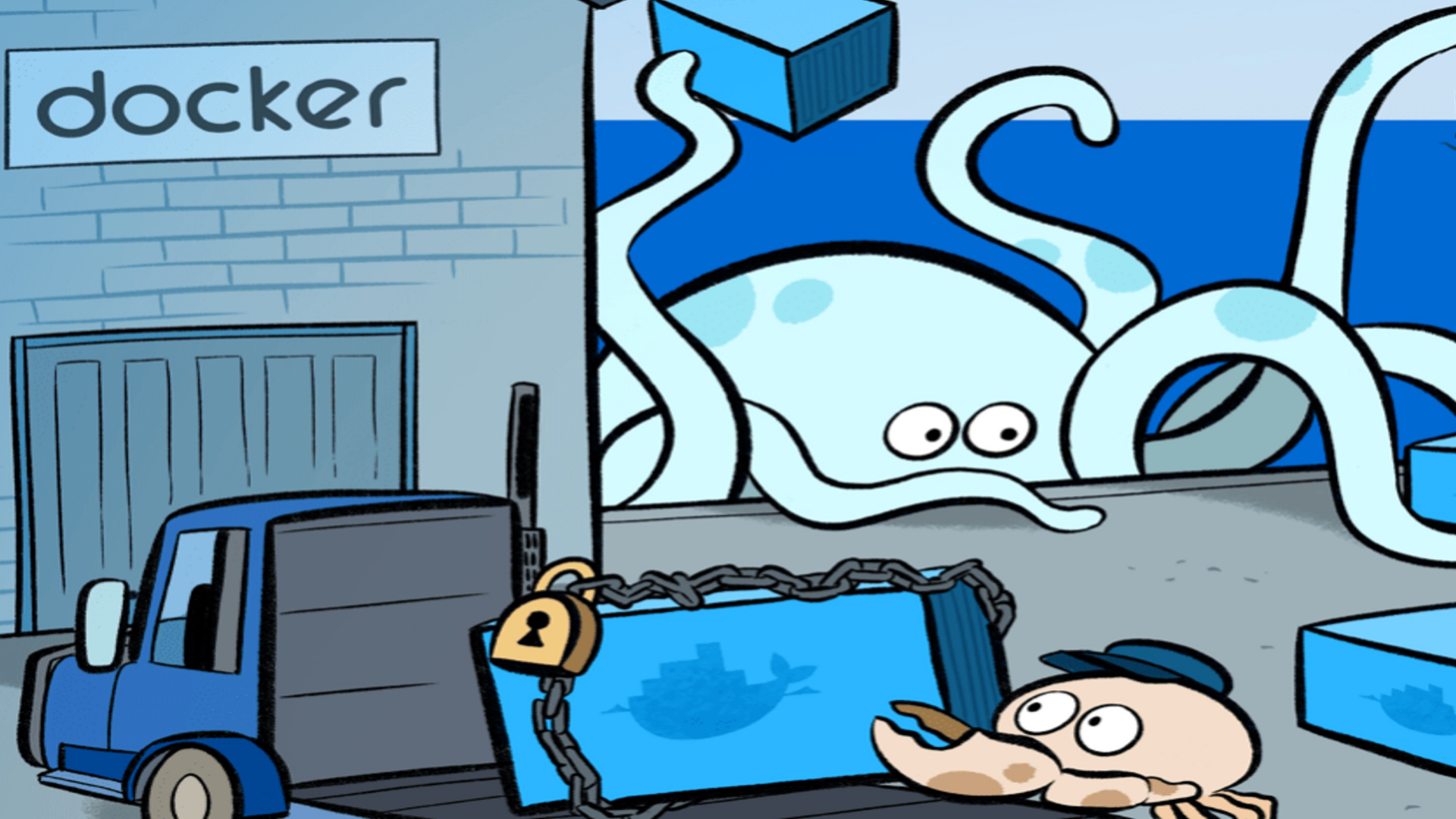
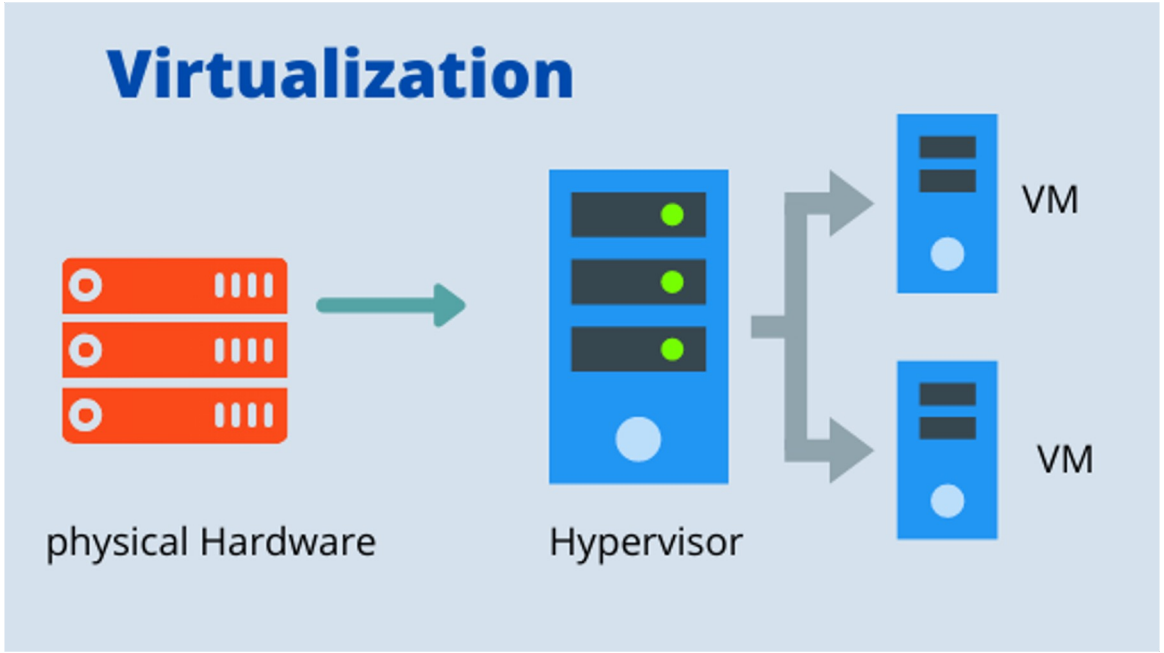
Docker


docker

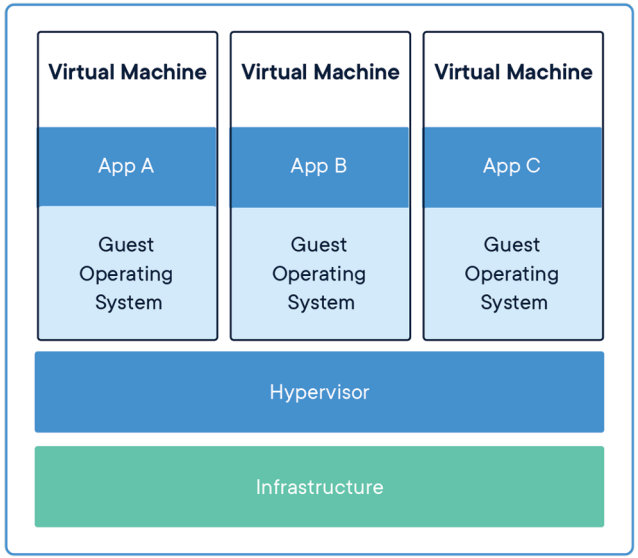
Why virtualization?



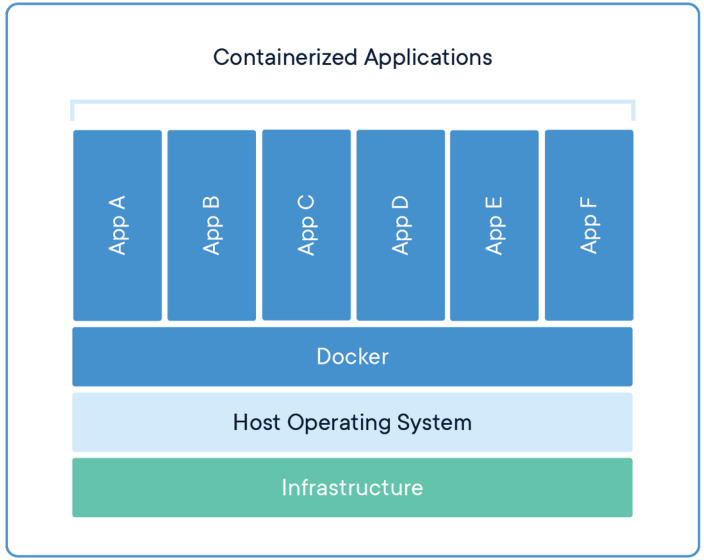
Why virtualization?

- Resource utilisation
- Security
- Isolation
- Scalability/Portability
- Easy backups
- Abstraction from hardware

Virtualisation containerisation



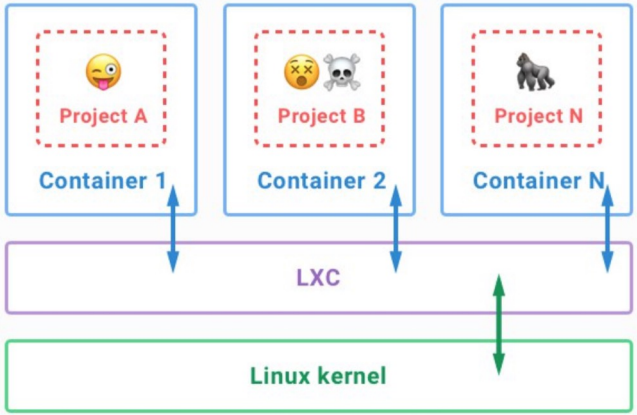
Virtual machines

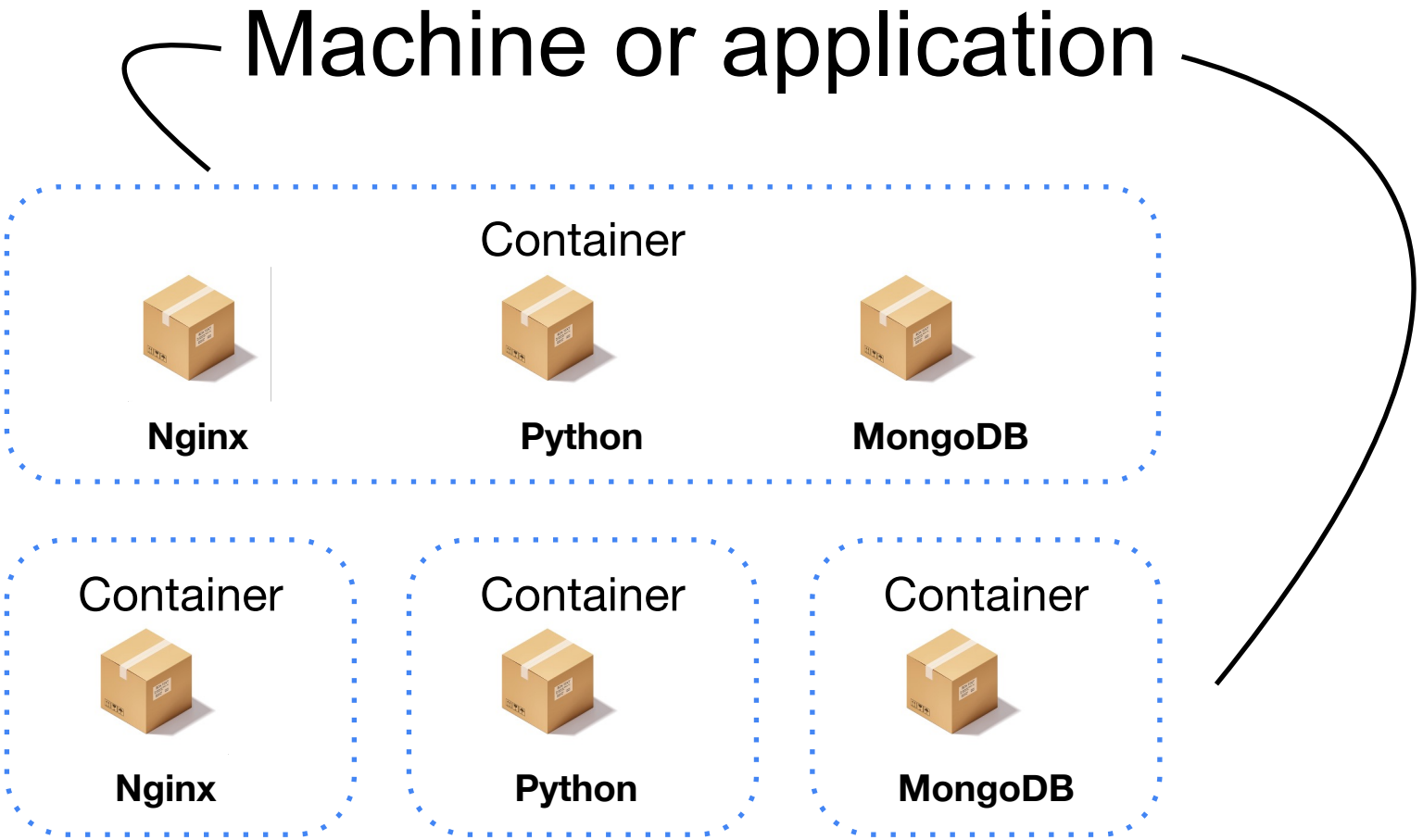


Containers

Containers != virtualization

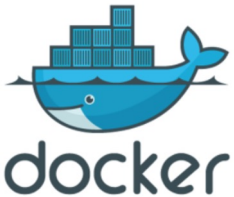
- 👍 Better performance
- 👍 File sharing between containers
- Limited OS support



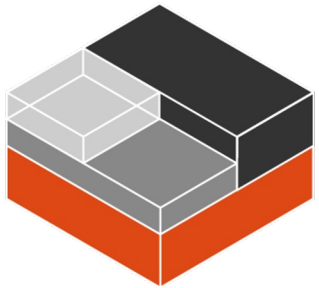

Machine or application
Container
Nginx
Python
MongoDB
Container
Nginx
Container
Python
Container
MongoDB

LXD or Docker

Docker hosts application containers



LXD hosts machine containers



Docker commands

Installation

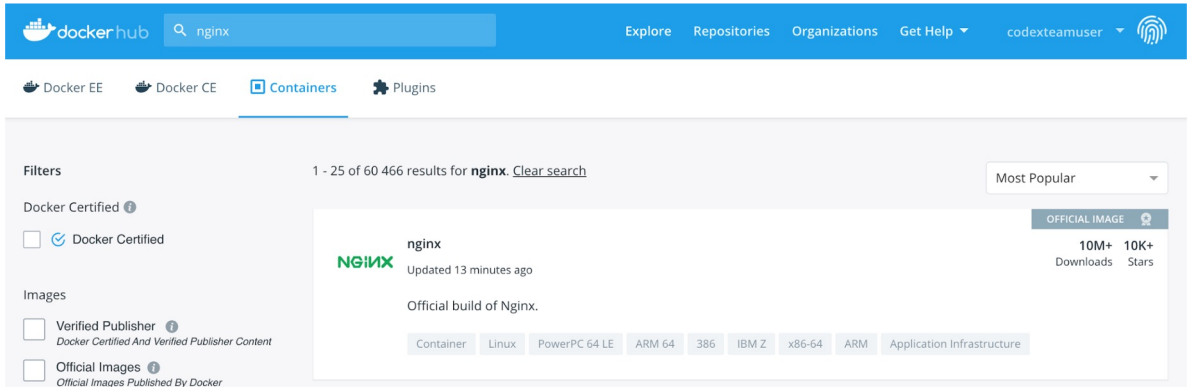
```
apt install -y apt-transport-https ca-certificates curl software-properties-common

curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -

add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu bion
ic stable"
apt install -y docker-ce
```

https://docs.docker.com/get-docker/

Elements

- Image
- Container
- Network
- Volume

Dockerhub

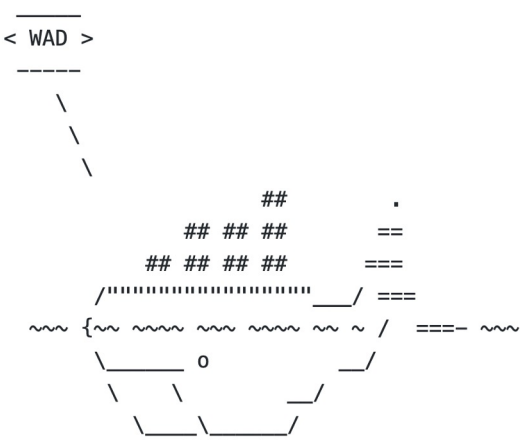


https://hub.docker.com/r/docker/whalesay/

Hello world

```
> docker pull docker/whalesay
```

```
> docker run docker/whalesay cowsay WAD
```



Images

```
> docker image ls
```

```
> docker image inspect docker/whalesay
```

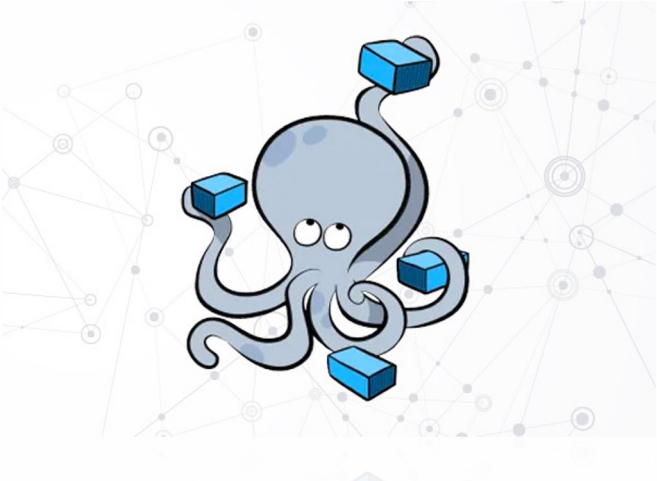
```
root@scw-recursing-tesla:~# docker image ls
REPOSITORY                    TAG                 IMAGE ID            CREATED             SIZE
root_flask                    latest              10b38c58159b        About an hour ago   210MB
root_flask-simple             latest              8695c3e97616        About an hour ago   210MB
codexteamuser/hawk-collector  prod                b921deac96e6        3 days ago          20.3MB
consul                        latest              197999eb696c        11 days ago         116MB
ubuntu                        latest              1d622ef86b13        11 days ago         73.9MB
nginx                         latest              602e111c06b6        12 days ago         127MB
python                        3.8.1-slim-buster   b99890b7a7dc        2 months ago        193MB
docker/whalesay               latest              6b362a9f73eb        4 years ago         247MB
```

Containers

```
> docker run -d ubuntu bash -c "while true; do sleep 3; done"

> docker ps

> docker ps --format "{{.ID}}\t{{.Image}}\t{{.Names}}"

d4021aab2350   ubuntu  cool_saha

> docker exec -it d4021aab2350 bash
```

```
root@d4021aab2350:/# ps uaxf
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root        66 13.3  0.1   4112  3400 pts/0    Ss   12:53   0:00 bash
root        74  0.0  0.1   5884  2908 pts/0    R+   12:53   0:00  \_ ps uaxf
root         1  0.2  0.1   3980  3156 ?        Ss   12:50   0:00 bash -c while true; do sleep 3; done
root        73  0.0  0.0   2512   588 ?        S    12:53   0:00 sleep 3
```

Docker-compose



Installation

```
Find current stable version: https://github.com/docker/compose/releases
and replace 1.25.5 word in the following command.

curl -L https://github.com/docker/compose/releases/download/1.25.5/docker-compose-
`uname -s`-`uname -m` -o /usr/local/bin/docker-compose
chmod +x /usr/local/bin/docker-compose
```

https://docs.docker.com/compose/install/

Docker-compose

```
version: "3.2"
services:
  nginx:
    image: nginx
    ports:
      - "80:80"
    volumes:
      - ./index.html:/usr/share/nginx/html/index.html
```

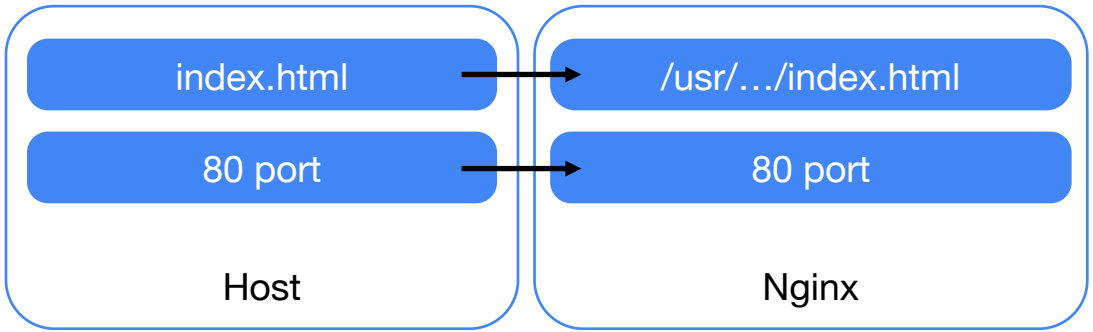
Docker-compose cli

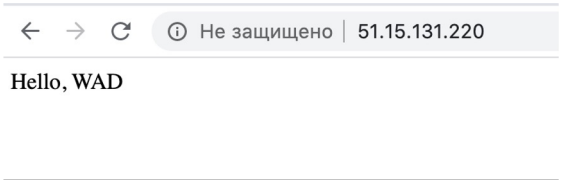
```
> docker-compose ps
> docker-compose build
> docker-compose up
> docker-compose down
> docker-compose up -d
```

Docker-compose

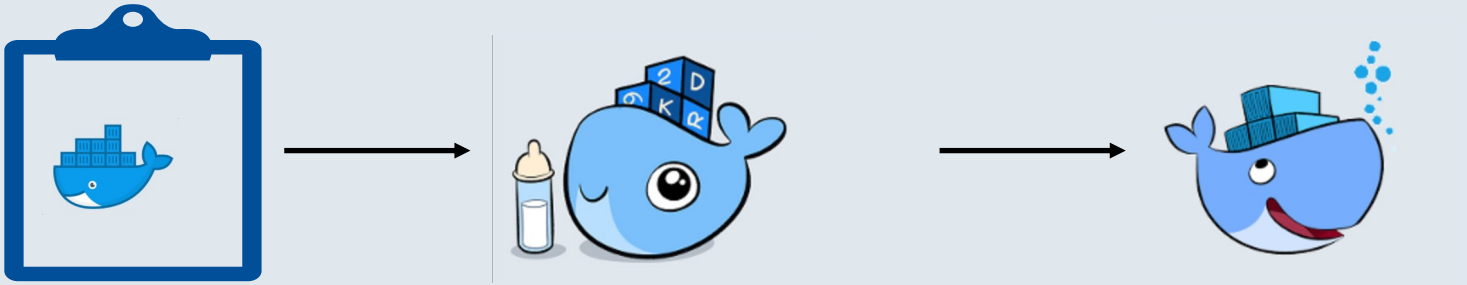
```
root@scw-recursing-tesla:~# docker ps
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS              PORTS                  NAMES
15432721d0f6        nginx               "nginx -g 'daemon of…"   About a minute ago   Up 1 second         0.0.0.0:80->80/tcp   root_nginx_1
```

```
root@scw-recursing-tesla:~# cat index.html
Hello, WAD
```





Dockerfile



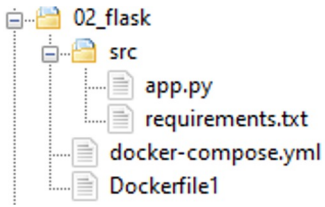
Flask app

```python
from flask import Flask, jsonify


app = Flask(__name__)


@app.route("/")
def hello_world():
    return jsonify(hello="world")

if __name__ == "__main__":
    app.run(port=5000, host="0.0.0.0")
```

./src/app.py

```
flask
```

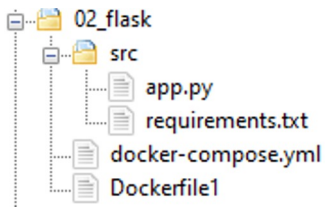
./src/requirements.txt



Dockerfile

```
FROM python:3.8.1-slim-buster

# set work directory
WORKDIR /usr/src/app

# install dependencies
RUN pip install --upgrade pip
COPY ./src/requirements.txt /usr/src/app/requirements.txt
RUN pip install -r requirements.txt
```

Dockerfile1

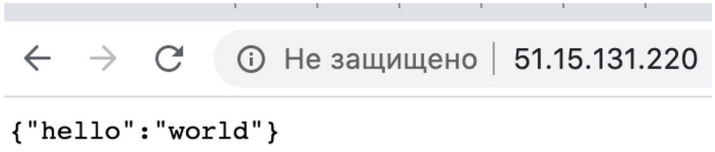


Compose

```
version: "3.2"
services:
  flask:
    build:
      dockerfile: Dockerfile1
      context: .
    ports:
      - "80:5000"
    command: python app.py
    volumes:
      - ./src:/usr/src/app/
```

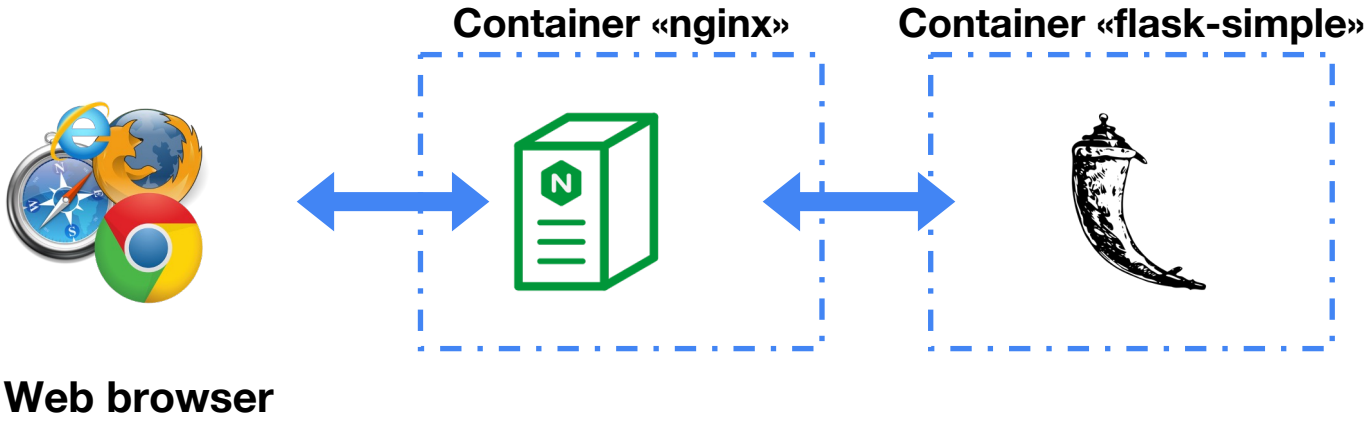
docker-compose.yml

```
root@scw-recursing-tesla:~# docker-compose up
WARNING: Found orphan containers (root_nginx_1) for this project. If you removed or renamed thi
Starting root_flask_1 ... done
Attaching to root_flask_1
flask_1  |  * Serving Flask app "app" (lazy loading)
flask_1  |  * Environment: production
flask_1  |    WARNING: This is a development server. Do not use it in a production deployment.
flask_1  |    Use a production WSGI server instead.
flask_1  |  * Debug mode: off
flask_1  |  * Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
```



Flask + Nginx
in Docker

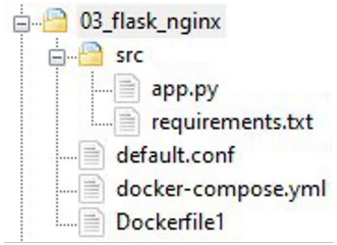
Web Application Architecture



Flask app

```
server {
    listen       80;
    server_name  localhost;

    location / {
        proxy_pass http://flask-simple:5000/;
    }
}
```

default.conf



docker-compose.yml

```
version: "3.2"
services:
  nginx:
    image: nginx
    ports:
      - "80:80"
    volumes:
      - ./default.conf:/etc/nginx/conf.d/default.conf
  flask-simple:
    build:
      dockerfile: Dockerfile1
      context: .
    command: python app.py
    volumes:
      - ./src:/usr/src/app/
```

Result

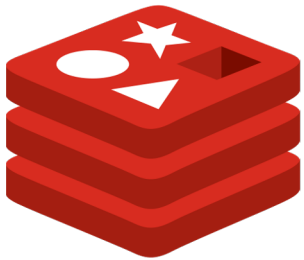
```
root@scw-recursing-tesla:~# docker-compose up
WARNING: Found orphan containers (root_flask_1) for this project. If you removed o
Starting root_flask-simple_1 ... done
Starting root_nginx_1        ... done
Attaching to root_nginx_1, root_flask-simple_1
flask-simple_1  |  * Serving Flask app "app" (lazy loading)
flask-simple_1  |  * Environment: production
flask-simple_1  |    WARNING: This is a development server. Do not use it in a pro
flask-simple_1  |    Use a production WSGI server instead.
flask-simple_1  |  * Debug mode: off
flask-simple_1  |  * Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
nginx_1         | 178.70.131.84 - - [05/May/2020:13:46:20 +0000] "GET / HTTP/1.1"
fari/537.36" "-"
flask-simple_1  | 172.18.0.2 - - [05/May/2020 13:46:20] "GET / HTTP/1.0" 200 -
flask-simple_1  | 172.18.0.2 - - [05/May/2020 13:46:20] "GET / HTTP/1.0" 200 -
nginx_1         | 178.70.131.84 - - [05/May/2020:13:46:20 +0000] "GET / HTTP/1.1"
fari/537.36" "-"
```

Literature

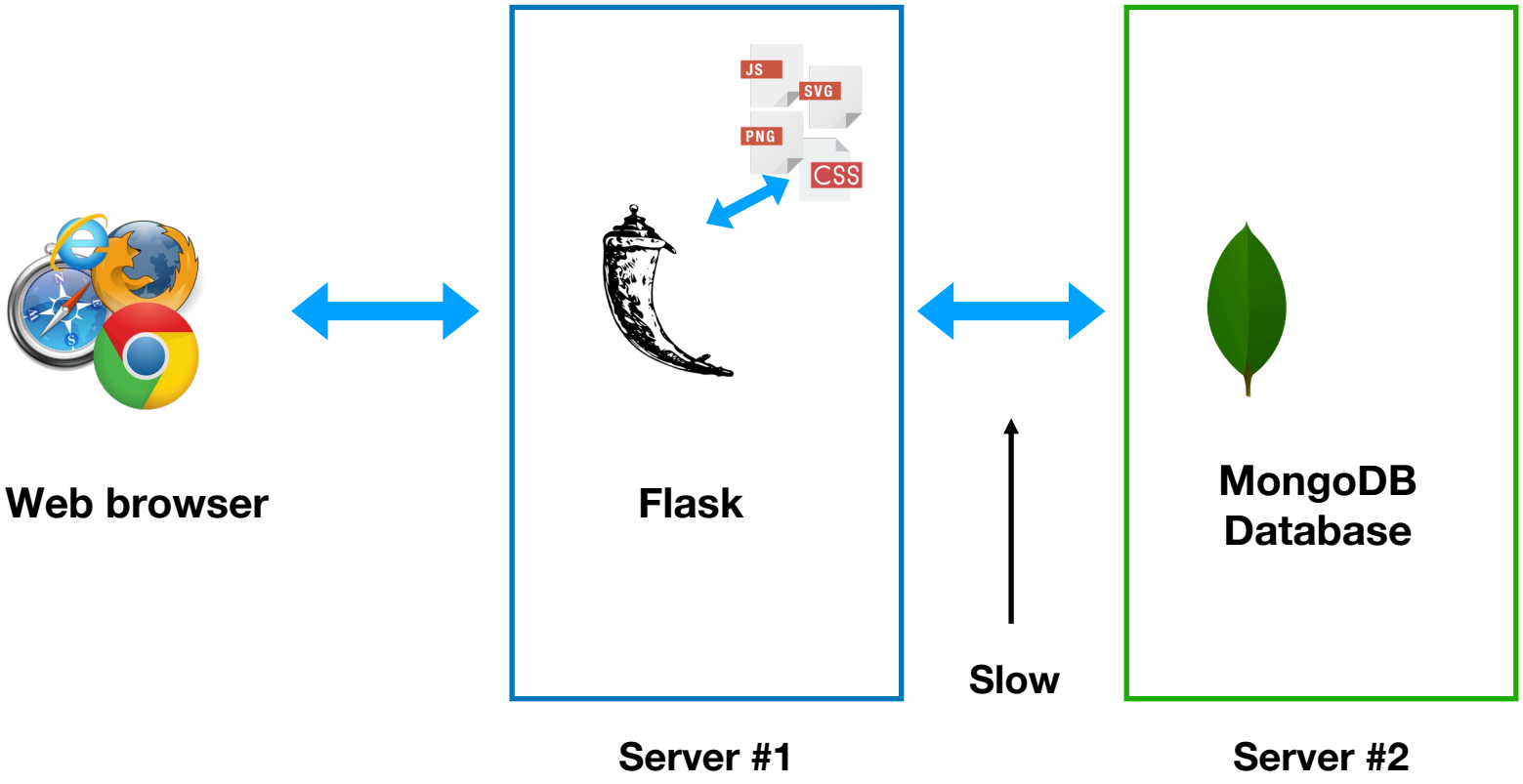
- Docker install: https://docs.docker.com/get-docker/
- Get started: https://docs.docker.com/get-started/
- Docker-compose install: https://docs.docker.com/compose/install/

Demo

Redis



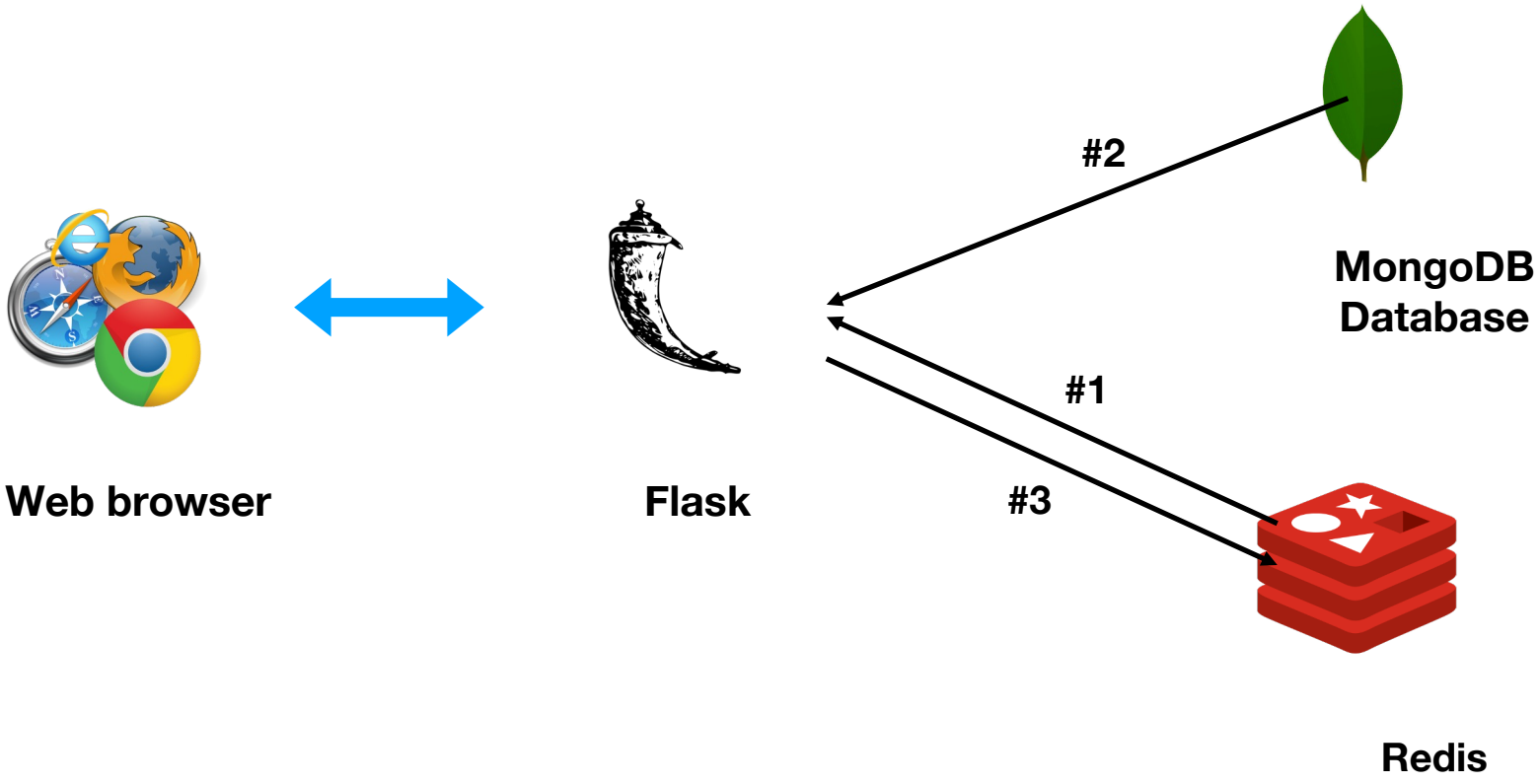
Web Application Architecture



Cache. Why?

- Faster delivery
- Reduce load

Web Application Architecture



Redis advantages

Redis

- In-memory
- Different data structures
- On-disk persistence
- Replication, transactions, high availability

Key-value

Data model

- Key
  - ASCII
- Value
  - Strings, Hashes, Lists, Sets, Sorted sets

SET/GET

```
127.0.0.1:6379> set user:1 '{"password": 123, "age": 20}'
OK
127.0.0.1:6379> set user:2 '{"password": 123, "age": 21}'
OK
127.0.0.1:6379> set user:3 '{"password": 123, "age": 22}'
OK
127.0.0.1:6379> GET user:1
"{\"password\": 123, \"age\": 20}"
```

HSET

```
127.0.0.1:6379> hset users 1 '{"password": 123, "age": 20}'
```
→ **(integer) 1**

```
127.0.0.1:6379> hset users 2 '{"password": 123, "age": 21}'
```
→ **(integer) 1**

```
127.0.0.1:6379> hset users 3 '{"password": 123, "age": 22}'
```
→ **(integer) 1**

```
127.0.0.1:6379> hexists users 1
```
→ **(integer) 1**

```
127.0.0.1:6379> hexists users 333
```
→ **(integer) 0**

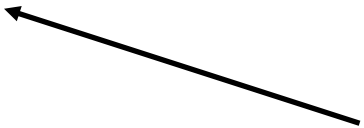
```
127.0.0.1:6379> hget users 1
```
→ **'{"password": 123, "age": 20}'**

```
127.0.0.1:6379> hgetall users
```

```
"{\"password\": 123, \"age\": 20}"
1) "1"
2) "{\"password\": 123, \"age\": 20}"
3) "2"
4) "{\"password\": 123, \"age\": 21}"
5) "3"
6) "{\"password\": 123, \"age\": 22}"
```

Redis in Flask

```
from flask_caching import Cache
...
app = Flask(__name__)
cache = Cache(app, config={
  'CACHE_TYPE': 'redis',
  'CACHE_REDIS_URL': 'redis://redis:6379/0'
})

@app.route("/<int:num>")
@cache.cached(timeout=10)
def index(num):
  for i in range(2, num):
    if num % i == 0:
      return f"Found divisor: {i}"
```

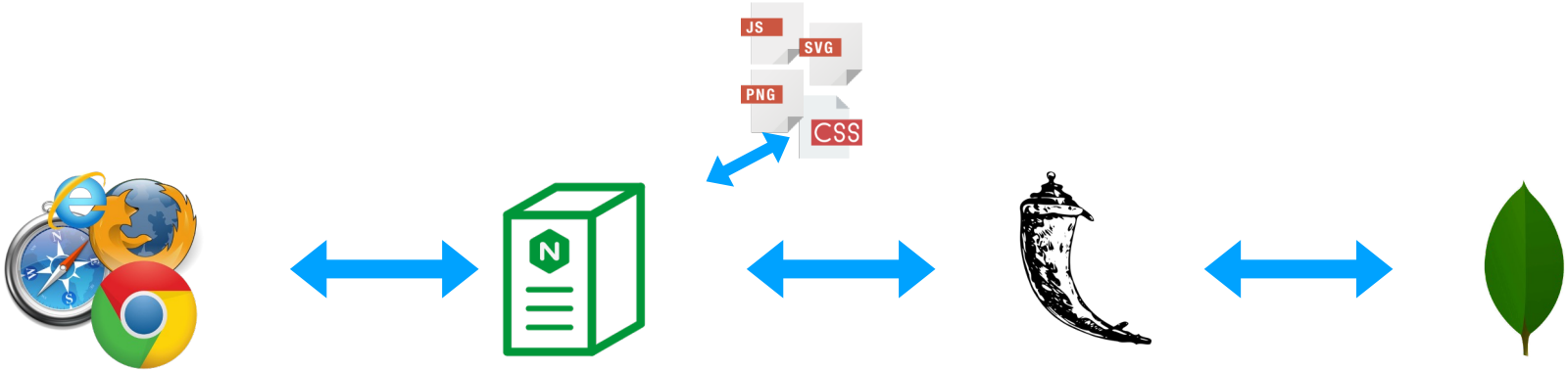


Redis in Docker

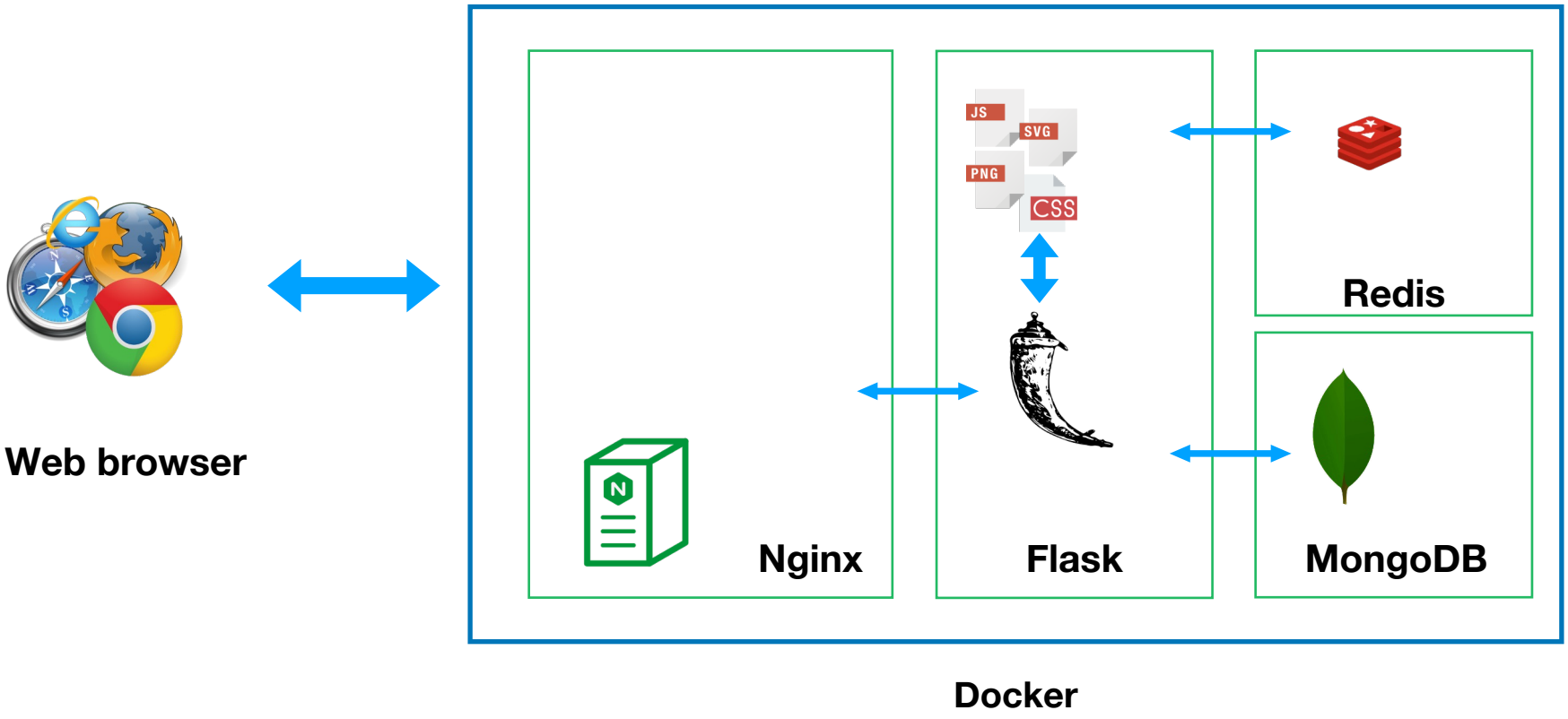
```yaml
version: "3.2"
services:
  flask-simple:
    build:
      dockerfile: Dockerfile1
      context: .
    command: python app.py
    ports:
      - "80:5000"
    volumes:
      - ./src:/usr/src/app/

  redis:
    image: redis
    volumes:
      - redisdata:/data
    ports:
      - "6379:6379"

volumes:
  redisdata:
```

```
> docker-compose ps

> docker exec -it
root_redis_1 redis-cli
```

Old Architecture



New Architecture



Literature

- Redis commands: https://redis.io/commands/

Demo