Docker Tutorial
What is Docker?

Docker is a tool that makes it easier to create, run and deploy applications

Docker allows developers to package libraries, dependencies, and other necessary parts for an application and ship it all out as one package
Docker Architecture
Docker Architecture

Docker is a client-server architecture

- Docker client (usually Docker CLI) talks to Docker daemon
- Docker registry stores images
What is a Dockerfile?

A Dockerfile is a text document that contains all the commands a user could call on the command line to assemble a Docker image.

```
FROM ubuntu:15.04
COPY . /app
RUN make /app
CMD python /app/app.py
```
What is a Docker Image?

A Docker container **image** is a lightweight, standalone, executable package of software

- Use `build` command to create an image from a Dockerfile
Docker images are built from a series of layers:

- 1 layer/instruction in Dockerfile
- Layers are essentially files generated from running a command in your Dockerfile
- Docker stores each layer on the host (for possible reuse later)
Docker Image Layers

FROM ubuntu
RUN apt-get update
RUN apt-get install -y apache2
RUN touch /opt/a.txt

$ docker history test/a

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>CREATED</th>
<th>CREATED BY</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4dc359259700</td>
<td>About a minute ago</td>
<td>/bin/sh -c touch /opt/a.txt</td>
<td>8 B</td>
</tr>
<tr>
<td>9977b78fbdad7</td>
<td>About a minute ago</td>
<td>/bin/sh -c apt-get install -y apache2</td>
<td>54.17 MB</td>
</tr>
<tr>
<td>e83b3bf07b42</td>
<td>2 minutes ago</td>
<td>/bin/sh -c apt-get update</td>
<td>20.67 MB</td>
</tr>
<tr>
<td>9cd978db300e</td>
<td>3 months ago</td>
<td>/bin/sh -c #(nop) ADD precise.tar.xz in /</td>
<td>204.4 MB</td>
</tr>
<tr>
<td>6170bb7b0ad1</td>
<td>3 months ago</td>
<td>/bin/sh -c #(nop) MAINTAINER Tianon Gravi &lt;ad</td>
<td>0 B</td>
</tr>
<tr>
<td>511136ea3c5a</td>
<td>10 months ago</td>
<td></td>
<td>0 B</td>
</tr>
</tbody>
</table>
Docker Image Layers

```
FROM ubuntu
RUN apt-get update
RUN apt-get install -y apache2
RUN touch /opt/b.txt
```

```
$ docker history test/b

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>CREATED</th>
<th>CREATED BY</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0daf4be2ed4</td>
<td>42 seconds ago</td>
<td>/bin/sh -c touch /opt/b.txt</td>
<td>8 B</td>
</tr>
<tr>
<td>9977b78fbad7</td>
<td>About a minute ago</td>
<td>/bin/sh -c apt-get install -y apache2</td>
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```
DockerHub Images

Repository of public images developers can use

Stable open-source images available to the public
What is a Docker Container?

If an image is a class, a container is an instance of the class → a runtime object

Containers are portable encapsulations of an environment to run an application

These containers are not static and can actually be written to
Docker Images vs Containers

The difference between a container and an image is the top writable layer

- Any writes to a container occur here
- can base multiple containers off same image (each container has own writable layer/unique data state)
What is a Data Volume?

A data volume is a specially designed directory in the container.

Main Uses:

- Persistent storage of data
- Mounting host directories
FROM python:3
ENV PYTHONUNBUFFERED 1
RUN mkdir /code
WORKDIR /code
ADD requirements.txt /code/
RUN pip install -r requirements.txt
ADD . /code/
What is Docker Compose?

Docker Compose is a tool for defining and running multi-container Docker applications

- Defined YAML file
Docker Container Networking

With multiple containers, a layer of networking is needed for communication (between each other and to the outside world).

Docker supports multiple network drivers but the most commonly used one (and the one we’ll use here) is the **bridge network (docker0)**.

Need to specify ports for containers to use to communicate between containers or from each container to the outside world.
Using Docker Compose

```
version: '2'

services:
  db:
    image: postgres
  web:
    build: ./web-app
    user: nobody
    command: bash -c "python3 manage.py makemigrations && python3 manage.py migrate && python3 manage.py runserver 0.0.0.0:8000"
    volumes:
      - ./web-app:/code
    expose:
      - "8000"
    depends_on:
      - db
  nginx:
    image: nginx:latest
    ports:
      - "8000:8000"
    volumes:
      - ./nginx/config:/etc/nginx/conf.d
    depends_on:
      - web
```
version: '2'
services:
  db:
    image: postgres
    volumes:
      - data-volume:/var/lib/postgresql/data
  web-init:
    build: ./web-app
    command: /code/initserver.sh
    volumes:
      - ./web-app:/code
    depends_on:
      - db
  web:
    build: ./web-app
    user: nobody
    command: /code/runserver.sh
    volumes:
      - ./web-app:/code
    expose:
      - "8000"
    depends_on:
      - web-init
  nginx:
    image: nginx:latest
    ports:
      - "8000:8000"
    volumes:
      - ./nginx/config:/etc/nginx/conf.d
    depends_on:
      - web
volumes:
  data-volume:
#!/bin/bash
python3 manage.py makemigrations
python3 manage.py migrate
res="$?"
while [ "$res" != "0" ]
  do
    sleep 3;
    python3 manage.py migrate
    res="$?"
  done
Command Scripts

```bash
#!/bin/bash
while [ "1"=="1" ]
  do
    python3 manage.py runserver 0.0.0.0:8000
    sleep 1
  done
```
Useful References

https://rominirani.com/docker-tutorial-series-a7e6ff90a023

https://docs.docker.com/v17.09/engine/userguide/storagedriver/imagesandcontainers/

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

https://thenewstack.io/container-networking-breakdown-explanation-analysis/

https://www.aquasec.com/wiki/display/containers/Docker+Networking+101