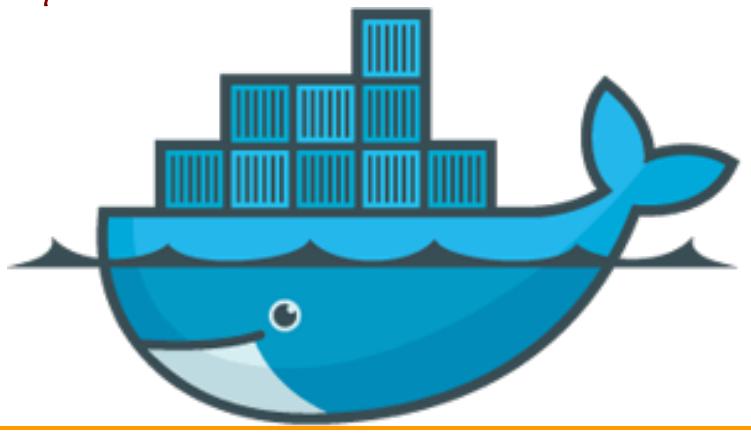
MSML 605 - Lecture 7

Containers

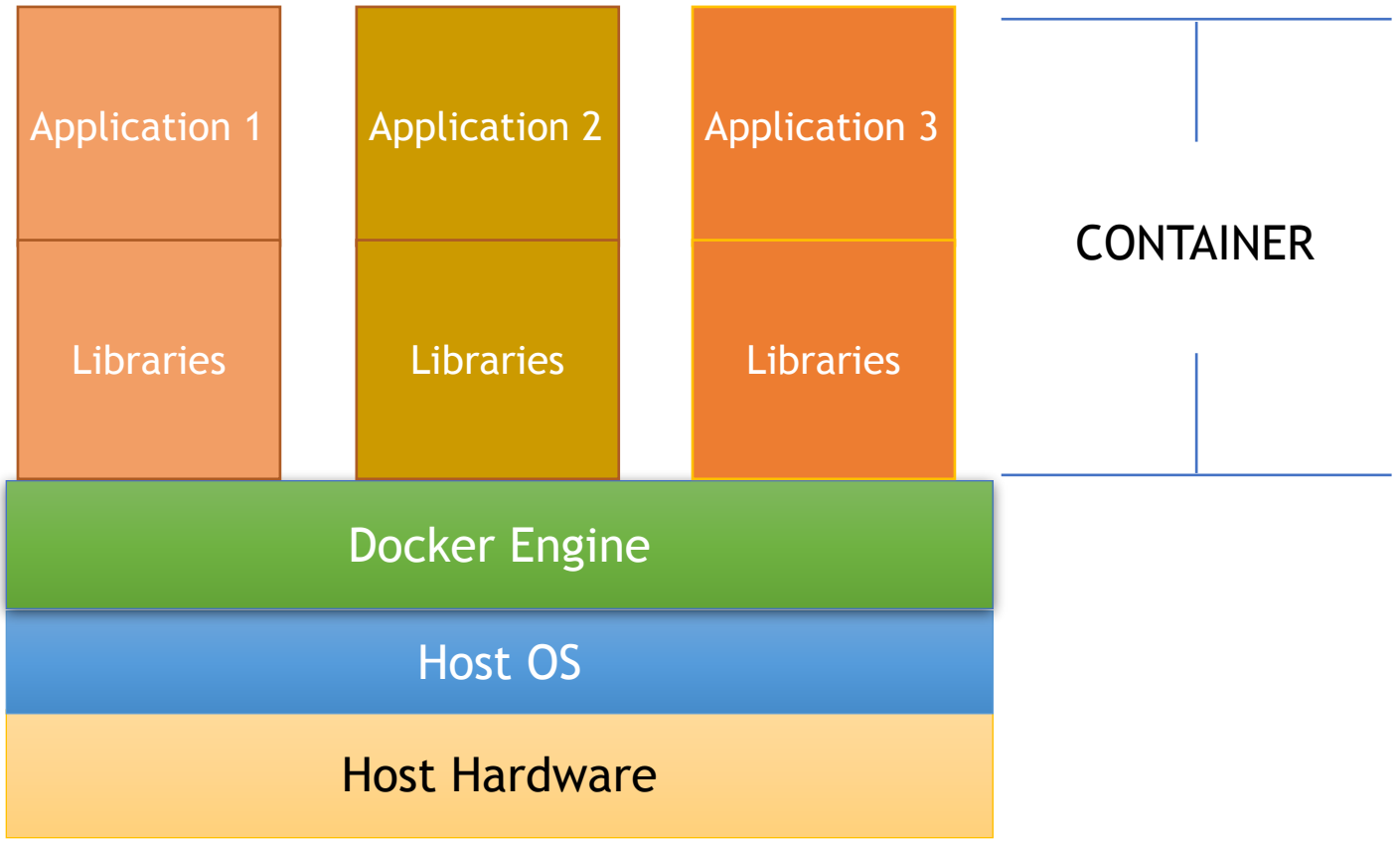


docker

Introduction

- Containers
  - Separate applications and its dependencies.
  - Remove physical hardware requirements.
- Docker is based on Linux containers

Docker Stack

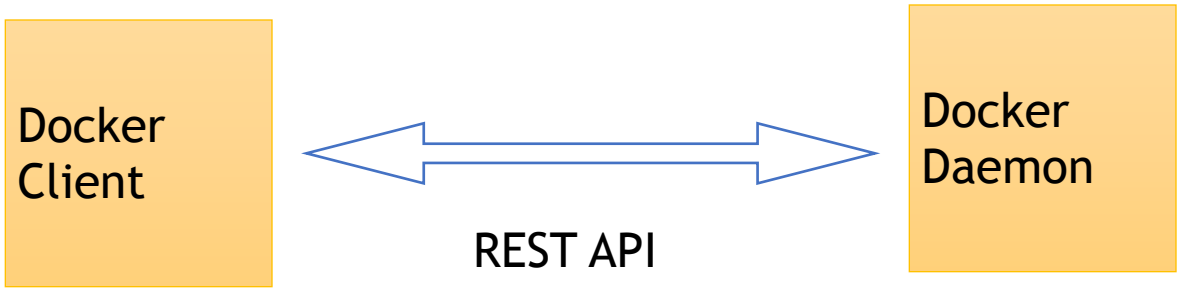


Docker

- Build an app once and run anywhere
- Containers take fewer resources
- Docker hub contains images available for use.

Docker Engine

- To do anything with docker you need to install docker engine.
- Get an OS specific image from https://docs.docker.com/get-docker/



- To check that it is installed: *docker —version*

Docker Engine

- To check that it is installed: *docker —version*

```
Docker version 19.03.8, build afacb8b
```

Docker Client

- It is the user interface
- You communicate with it.
- It communicates with the Docker Daemon

Docker Daemon

- It executes the commands you send to the client.
- For example, building, running, and distributing your containers.

Dockerfile

- It contains the instructions to build a Docker image.
- For example, to install a software, set environmental variables etc.
- Use *docker build* command to build an *image* from it.
- Docker uses a Union file system.
- Once you run the image it is a *container*

Docker Project - dockerApp

- Python file: *code.py*

```
import numpy as np

print('Numpy version:',np.__version__)
```

- *Requirements.txt* file

```
-i https://pypi.org/simple
numpy = 1.17.4
pandas = 0.24.2
matplotlib = 3.1.2
```

Dockerfile

```
FROM python:3.7-slim

COPY requirements.txt /dockerApp/
WORKDIR /dockerApp

RUN pip install --upgrade pip \
 && pip install --trusted-host pypi.python.org --requirement requirements.txt


COPY code.py /dockerApp


CMD ["python","code.py"]
```

Dockerfile

```
FROM python:3.7-slim

COPY requirements.txt /dockerApp/
WORKDIR /dockerApp

RUN pip install --upgrade pip \
 && pip install --trusted-host pypi.python.org --requirement requirements.txt


COPY code.py /dockerApp


CMD ["python","code.py"]
```

- FROM: get a parent image from the docker hub Each command int eh docker file uses this parent image.
- Copy requirements file into the dockerApp folder

Dockerfile

```
FROM python:3.7-slim

COPY requirements.txt /dockerApp/
WORKDIR /dockerApp

RUN pip install --upgrade pip \
 && pip install --trusted-host pypi.python.org --requirement requirements.txt


COPY code.py /dockerApp


CMD ["python","code.py"]
```

- Set dockerApp as the working directory
- Run pip commands :
  - First to upgrade pip in the parent image
  - Second install all the dependencies in *requirements.txt* in the parent image.

Dockerfile

```
FROM python:3.7-slim

COPY requirements.txt /dockerApp/
WORKDIR /dockerApp

RUN pip install --upgrade pip \
 && pip install --trusted-host pypi.python.org --requirement requirements.txt


COPY code.py /dockerApp


CMD ["python","code.py"]
```

- Copy the app, *code.py* to the dockerApp
- Define what command gets executed.

Docker Image

```
docker build --tag=msmldockerimage .
```

```
Sending build context to Docker daemon   5.12kB
Step 1/6 : FROM python:3.7-slim
 ---> 74ac77e9873a
Step 2/6 : COPY requirements.txt /dockerApp/
 ---> 66e640d1c0db
Step 3/6 : WORKDIR /dockerApp
 ---> Running in ee49306b6437
Removing intermediate container ee49306b6437
 ---> 79ca3e240516
Step 4/6 : RUN pip install --upgrade pip  && pip install --trusted-host pypi.python.org --requirement requirements.txt
 ---> Running in 95f472b978fe
Requirement already up-to-date: pip in /usr/local/lib/python3.7/site-packages (20.0.2)
Collecting numpy==1.17.4
  Downloading numpy-1.17.4-cp37-cp37m-manylinux1_x86_64.whl (20.0 MB)
Collecting pandas==0.24.2
  Downloading pandas-0.24.2-cp37-cp37m-manylinux1_x86_64.whl (10.1 MB)
Collecting matplotlib==3.1.2
  Downloading matplotlib-3.1.2-cp37-cp37m-manylinux1_x86_64.whl (13.1 MB)
Collecting pytz>=2011k
  Downloading pytz-2019.3-py2.py3-none-any.whl (509 kB)
Collecting python-dateutil>=2.5.0
  Downloading python_dateutil-2.8.1-py2.py3-none-any.whl (227 kB)
Collecting kiwisolver>=1.0.1
  Downloading kiwisolver-1.2.0-cp37-cp37m-manylinux1_x86_64.whl (88 kB)
Collecting cycler>=0.10
  Downloading cycler-0.10.0-py2.py3-none-any.whl (6.5 kB)
Collecting pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1
  Downloading pyparsing-2.4.7-py2.py3-none-any.whl (67 kB)
Collecting six>=1.5
  Downloading six-1.14.0-py2.py3-none-any.whl (10 kB)
Installing collected packages: numpy, pytz, six, python-dateutil, pandas, kiwisolver, cycler, pyparsing, matplotlib
Successfully installed cycler-0.10.0 kiwisolver-1.2.0 matplotlib-3.1.2 numpy-1.17.4 pandas-0.24.2 pyparsing-2.4.7 python-dateutil-2.8.1 pytz
-2019.3 six-1.14.0
Removing intermediate container 95f472b978fe
 ---> b34a6b08f847
Step 5/6 : COPY code.py /dockerApp
 ---> dc16362933d9
Step 6/6 : CMD ["python","code.py"]
 ---> Running in 676d95b34c9f
Removing intermediate container 676d95b34c9f
 ---> ce20b48cecb4
Successfully built ce20b48cecb4
Successfully tagged msmldockerimage:latest
```

List all local images

```
docker image ls
```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
msmldockerimage	latest	ce20b48cecb4	About a minute ago	386MB
firstdockerimage	latest	d7e061293f39	18 minutes ago	386MB
<none>	<none>	c43425b4027e	18 minutes ago	386MB
<none>	<none>	4fdc8ffa8e58	22 minutes ago	386MB
<none>	<none>	337518bfbc18	26 minutes ago	386MB
dockimage	latest	037e9db66dca	16 hours ago	386MB
<none>	<none>	8b7f78c036ce	16 hours ago	179MB
helloapp	v1	b9485b71c61c	46 hours ago	1.22MB
python	3.7-slim	74ac77e9873a	2 weeks ago	179MB
busybox	latest	83aa35aa1c79	5 weeks ago	1.22MB
jupyter/datascience-notebook	latest	029fd3e52059	11 months ago	5.49GB
hello-world	latest	fce289e99eb9	15 months ago	1.84kB

```
docker run --rm msmldockerimage
```

```
Numpy version: 1.17.4
```

Docker hub

- There is a container registry at Docker hub
- 1 free private repository
- Go to https://hub.docker.com/
- Create a username followed by a new repository, msml605 (private)

Docker hub

- <username>/msml605 (private)

Docker commands

To push a new tag to this repository,

```
docker push nayeemmz/msml605:tagname
```

- Associate your image to this repository on docker hub

```
docker tag msmldockerimage:latest nayeemmz/msmldockerimage:latest
```

List docker images

- Associate your image to this repository on docker hub

```
docker tag msmldockerimage:latest nayeemmz/msmldockerimage:latest
```

- *docker image ls*

```
REPOSITORY                    TAG                 IMAGE ID            CREATED             SIZE
msmldockerimage               latest              ce20b48cecb4        31 minutes ago      386MB
nayeemmz/msmldockerimage      latest              ce20b48cecb4        31 minutes ago      386MB
firstdockerimage              latest              d7e061293f39        48 minutes ago      386MB
<none>                        <none>              c43425b4027e        49 minutes ago      386MB
<none>                        <none>              4fdc8ffa8e58        52 minutes ago      386MB
<none>                        <none>              337518bfbc18        56 minutes ago      386MB
dockimage                     latest              037e9db66dca        17 hours ago        386MB
<none>                        <none>              8b7f78c036ce        17 hours ago        179MB
helloapp                      v1                  b9485b71c61c        47 hours ago        1.22MB
python                        3.7-slim            74ac77e9873a        2 weeks ago         179MB
busybox                       latest              83aa35aa1c79        5 weeks ago         1.22MB
jupyter/datascience-notebook  latest              029fd3e52059        11 months ago       5.49GB
hello-world                   latest              fce289e99eb9        15 months ago       1.84kB
```

Push local image to docker

- You may need to login

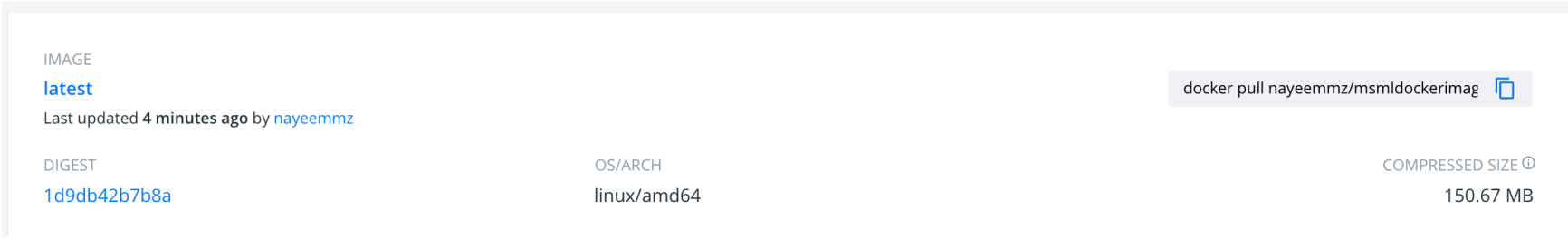
```
docker login
```

```
docker push nayeemmz/msmldockerimage
```

```
The push refers to repository [docker.io/nayeemmz/msmldockerimage]
9f1eefabe514: Pushed
a158808d8ac7: Pushed
50f7a330b9f2: Pushed
76d8d23d2ffc: Mounted from library/python
3d93c3dfdc9a: Mounted from library/python
17e50dfd399c: Mounted from library/python
07081806a448: Mounted from library/python
c3a984abe8a8: Mounted from library/python
latest: digest: sha256:1d9db42b7b8a7394cb863ae6fb3ff24dc1cb2f50f676b4587e67d4b15bdaabee size: 1996
```

Docker hub

- There is a pull request



Docker hub

- Run the remote image

```
docker run --rm nayeemmz/msmldockerimage
```

- Or pull from docker hub and run locally

```
docker pull nayeemmz/msmldockerimage
```

Requirements file

- Dependency manager — *pipenv*
- Uses *pip* and *virtualenv*
- *For user installation*

```
pip install --upgrade setuptools wheel
```

```
pip install --user pipenv
```

Set up the PATH

- vi ~/.bash_profile

```
export PATH="/Users/nayeem/.local/bin:$PATH"
```

- *In the terminal*

```
source ~/.bash_profile
```

```
echo $PATH | tr ':' '\n'
```

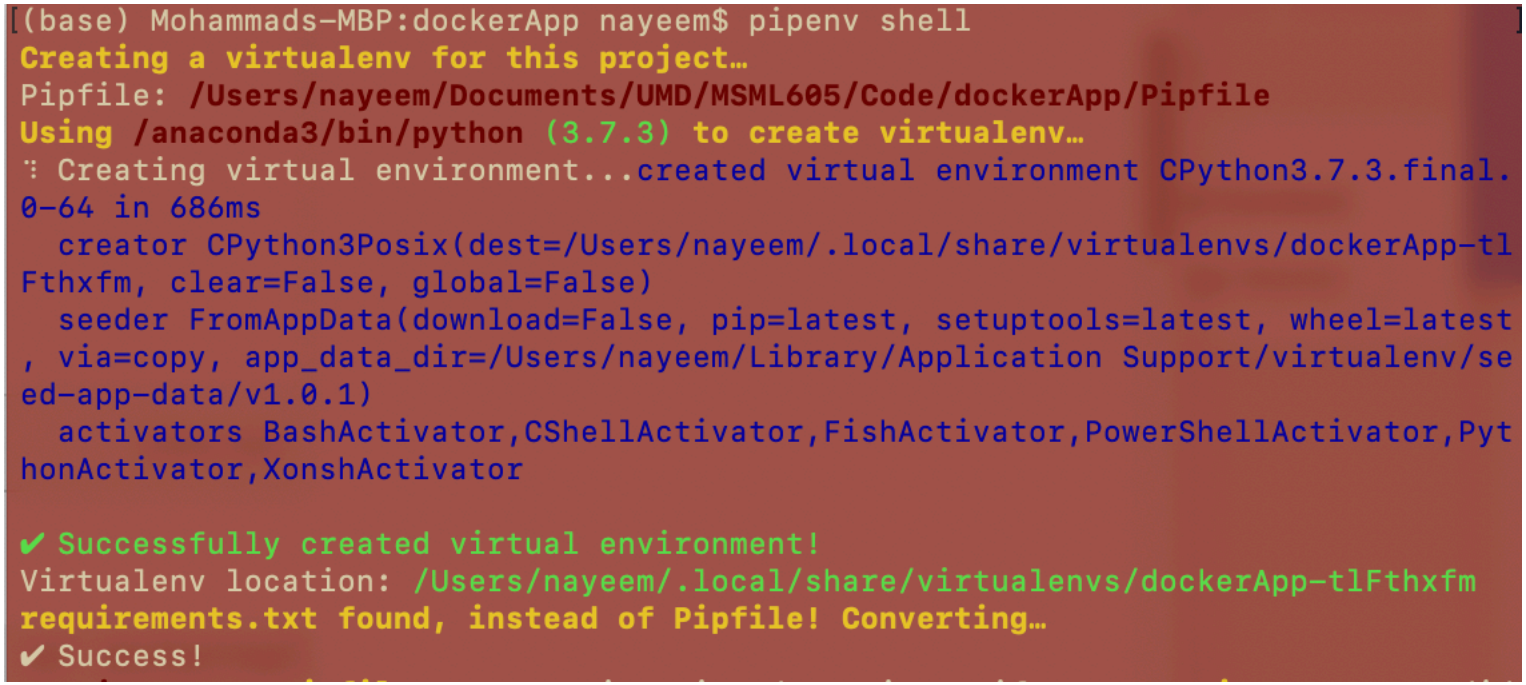
pipenv

pipenv

```
(base) Mohammads-MBP:~ nayeem$ pipenv
Usage: pipenv [OPTIONS] COMMAND [ARGS]...

Options:
  --where             Output project home information.
  --venv              Output virtualenv information.
  --py                Output Python interpreter information.
  --envs              Output Environment Variable options.
  --rm                Remove the virtualenv.
  --bare              Minimal output.
  --completion        Output completion (to be eval'd).
  --man               Display manpage.
  --support           Output diagnostic information for use in GitHub issues.
  --site-packages     Enable site-packages for the virtualenv.  [env var:
                      PIPENV_SITE_PACKAGES]
  --python TEXT       Specify which version of Python virtualenv should use.
  --three / --two     Use Python 3/2 when creating virtualenv.
  --clear             Clears caches (pipenv, pip, and pip-tools).  [env var:
                      PIPENV_CLEAR]
  -v, --verbose       Verbose mode.
  --pypi-mirror TEXT  Specify a PyPI mirror.
  --version           Show the version and exit.
  -h, --help          Show this message and exit.
```

pipenv - shell to install packages



pipenv - to install packages

```
[(dockerApp) bash-3.2$ pipenv install pandas
Installing pandas…
Adding pandas to Pipfile's [packages]…
✔ Installation Succeeded
Pipfile.lock not found, creating…
Locking [dev-packages] dependencies…
Locking [packages] dependencies…
✔ Success!
Updated Pipfile.lock (0b6fa6)!
Installing dependencies from Pipfile.lock (0b6fa6)…
   🐍  ████████████████████████████████ 9/9 — 00:00:09
[(dockerApp) bash-3.2$ pipenv install numpy
Installing numpy…
Adding numpy to Pipfile's [packages]…
✔ Installation Succeeded
Installing dependencies from Pipfile.lock (0b6fa6)…
   🐍  ████████████████████████████████ 9/9 — 00:00:06
```

```
pipenv run python code.py
```

```
Numpy version: 1.17.4
```

pipenv - requirements file

```
pipenv lock -r >requirements.txt
```

```
[(dockerApp) bash-3.2$ cat requirements.txt
-i https://pypi.org/simple
cycler==0.10.0
kiwisolver==1.2.0
matplotlib==3.1.2
numpy==1.17.4
pandas==0.24.2
pyparsing==2.4.7
python-dateutil==2.8.1
pytz==2019.3
six==1.14.0
```